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INITIAL LABOR MARKET CONDITIONS, HOUSING MARKETS, AND WELFARE

Rodrigo Martínez-Mazza

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ABSTRACT: Young individuals are currently living with their parents more than at any other point in time, while also spending more on housing. In this paper, I first show how labor market entry conditions affect housing tenure and affordability in the long term, by using the unemployment rate at the time of graduation as an exogenous shock to income. I perform this analysis across Europe for the last 25 years. Results indicate that a 1 pp increase in the unemployment rate at the time of graduation leads, one year after, to (1) a 1.50 pp increase in the probability of living with parents, (2) a 1.02 pp decrease in the probability of home-ownership and 0.45 pp decrease in renting, and (3) worse affordability. Second, I develop an OLG model to link income shocks for young agents with changes in housing tenure at the aggregate level. I allow for an outside option for landlords which can introduce rigidity into the rental market. Results show that if rental markets are rigid, an income shock to young agents will translate into a larger share of them living with their parents, worse affordability, and larger welfare losses. Finally, I perform a policy exercise based on the French housing aid system. I show that housing aid policies can help to recover welfare losses for young agents, by enabling them to afford to rent. Recognizing the right scenario for the implementation of these policies is key to ensure welfare gains concentrate on the targeted population.

JEL Codes: R20, R21, J24

Keywords: Housing, labor markets, long-term effects

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1 Introduction

Around the world, young people are not leaving the parental home; in 2020 more than 50% of young US population (aged between 18 and 29 years old) were living with their parents, the highest level since the great depression (Fry et al., 2020), and a 20 percentage points increase with respect to the 1980 average. In Europe, 69% of those between 16 and 29 years old were living with their parents in 2019 (Eurostat, data for EU-19), for several countries this implies the highest value since the 1980's (Schwanitz and Mulder, 2015). Additionally, young people are facing major affordability challenges;[1] millennials across the world are spending more on housing than any previous generation, while experiencing a lower quality of life (Judge and Tomlinson, 2018). Previous evidence suggests that these phenomena could be harming their welfare. Specifically, living with your parents as an adult is associated with a negative social stigma (Parker, 2012), worse adult child-parent relationships (Lang (2015) and Tosi (2020)), delayed family formation (Parker, 2012), and a overall reduction in satisfaction with personal well-being (Fuller-Tyszkiewicz et al., 2016). Additionally, financial stress, such as that deriving from bad affordability, can lead to poorer physical and mental health outcomes (French and McKillop (2017) and Vásquez-Vera et al. (2017)), and lower overall well-being (Netemeyer et al., 2018).

A potential explanation for these phenomena lies in the conditions faced by individuals when first entering the labor market. For young Europeans, initial labor market conditions have recently been tough; the unemployment rate among those aged between 15 and 24 years old in the EU was 22% for the 2008-2017 period, five percentage points higher than for the 1998-2007 period (OECD, data for EU-19). A lower income can mean an inability to afford to rent or buy and consequently the need to stay in the parental home. For those who do leave, this may translate into worse affordability. However, bad initial labor market conditions affect entire cohorts rather than just single individuals, so the interaction between the labor and housing markets could be important. Specifically, if prices and rents are flexible and adjust fully to new income levels, housing tenure should not change. If housing markets are rigid, however, then prices and rents fall to a lesser extent than income. This forces young people to live with their parents, thereby worsening their welfare even further.

In this paper, I study how initial labor market conditions can have long-term effects on housing tenure and affordability. To determine the long-term effects of initial labor market conditions, the ideal experiment would involve randomly exposing identical graduates to different initial employment conditions (von Wachter, 2020). The best approach to this experiment so far has consisted of comparing graduates who entered different labor markets with different unemployment rates. This strategy has been used extensively in the labor literature (Kahn (2010), Oreopoulos et al. (2012), Schwandt and Von Wachter (2019)). In this research, I exploit the unemployment rate at the time of college graduation as an exogenous income shock to study housing outcomes, I do so by comparing different cohorts of college graduates across different European countries. As the vast majority of college graduates enter the labor market and become economically active immediately after graduation, they constitute the best subjects for studying the effects of initial labor market conditions. Additionally, by working at the country level, concerns regarding the migration of graduates to other labor markets with better conditions are mitigated, as migration

[1] Namely, the ratio between housing costs and household income

between EU countries is very low (Dijkstra and Gakova, 2008). The empirical specification follows a cell-based model, in which outcomes are aggregated at the country, year of graduation, and calendar year, and outcomes are regressed against the unemployment rate at the country and year of graduation.

For this research I use micro-data from two major European datasets: the European Union Statistics on Income and Living Conditions (EU-SILC) and the European Community Household Panel (ECHP). Both surveys provide cross-sectional information on various factors such as income, labor and housing conditions, at both the individual and household level. The ECHP originally covered Belgium, Denmark, Germany, Ireland, Greece, Spain, France, Italy, Luxembourg, the Netherlands, Austria, Portugal, Sweden and the United Kingdom, for the period between 1994 and 2001. After it was discontinued in 2001, the survey was replaced by the EU-SILC, which addressed virtually the same factors. Furthermore, the EU-SILC sample progressively included other European nations, reaching up to 33 countries by 2018, and include over 10 million individuals. Using these data made it possible to study the effect of labor market entry in bad times for cohorts from 1960 until 2018. This is the first paper to do so for the entire European Union and, for such a long period of time, due mainly to the use of cross-sectional data.

This empirical approach provides three key findings. First, the results confirm the negative, scarring effects that entering the labor market under bad economic conditions has on housing tenure and affordability. Particularly, a 1 pp increase in the unemployment rate at the time of graduation leads to a 1.5 pp increase in the probability of living with parents one year after graduation, which is equal to an increase of 2.9% with respect to the mean. Effects are persistent over time and are still present 10 years after graduation, with the accumulated effect after 10 years being 12.5 pp. Second, the results show that a 1 pp increase in the unemployment rate at the time of graduation decreases the probability of renting by -1.02 pp (-4.9% with respect to the mean) and by -0.45 pp (-2.0% with respect to the mean) for homeowner one year after graduation. Third, worse initial labor market conditions translate into worse affordability ratios for homeowners and renters. These are due to lower household income and unchanging rents or prices. Additionally, the results confirm that worse initial labor market conditions lead to lower earnings, lower employment probability, lower employment quality, higher probability of receiving governmental housing aid and lower probability of being married or having a child. These results are in line with previous studies.

In this setting, however, it is imperative to analyze how housing markets can absorb or amplify the initial labor market shock. To understand this, I develop an OLG model in which agents live for three periods and have three different housing tenure choices (living with parents, renting and, owning). Agents accumulate housing and non-housing wealth, and consume a numeraire good. In my model, agents prefer ownership over renting, and renting over living with parents. Additionally, as younger agents are poorer than older agents, this implies that they will be outbid in the housing market and only young agents will be forced to live with their parents. As for the rental market, I allow only older agents to become landlords, which makes the rental supply endogenous. Also, I introduce an outside option for the rental market, and landlords will choose the outside option if the rent they obtain from young agents is too low. The existence of outside options in the rental market has been documented in several ways; for example as conversion of residential units to short-term tourism accommodation (Garcia-López et al., 2020), as conversion to office

units (Beauregard, 2005), or leaving the unit empty (Segú, 2020). The outside option will work as a floor price for rents, thereby introducing rigidity into the rental market.

I use the model to explore what would happen if there is a permanent and negative income shock to young agents only. In particular, I study two different scenarios. In the first scenario, the outside option is not binding so rental markets are flexible ($\Delta\%income = \Delta\%rents$). In this case, income shock in young agents will not change the share of agents living with their parents, as rents fully adjust to the young agents' new income. However, as housing prices depend on the income of both young and old agents, they will not fall as much as the income of young agents, thus reducing the share of young homeowners. Affordability for young renters will not worsen as rents fall in the same proportion as their income. In the second scenario, with the rental outside option active, rental markets are rigid ($\Delta\%income > \Delta\%rents$). In this case, the model predicts that the share of young agents living with their parents will increase, as some can no longer afford to rent. As in the previous case, prices are not fully responsive to changes in the income of young agents, so the share of young homeowners decreases. For young renters affordability will get worse, as their incomes decrease but rents do not. In both scenarios, the welfare of young agents decreases, but this is more pronounced when rental markets are rigid, as the share of agents in their least preferred housing tenure option increases and affordability ratios are worse.

Additionally, this model is also useful to provide policy insights. In this regard, the numerical solution of the model provides some understanding into housing policies when there is a negative income shock to young individuals. To achieve this, I use housing allowances in France as a case study. This is an relevant case, as almost one in three French households receive a housing allowance, one of the highest rates in the OECD. Additionally, at 0.72% of national GDP, these allowances account for a large part of government spending, i.e. the fourth largest expenditure in the OECD (OECD, 2018). On average households receive 30% of their housing expenditure, with 90% living in rental units (Hananel and Richet-Mastain, 2019). In the model, I translate this policy into one in which 30% of poorest agents receive housing aid equivalent to 30% of the rental market price. The results indicate that this type of policy is effective at alleviating the welfare impact of negative income shocks in rigid rental markets. Such policies can help recover part of the lost welfare due to a labor market shock, as it helps young agents access rental units and improve their affordability ratio. However, this policy creates the opposite results when applied in flexible rental markets scenarios, as it does not allow for rents and prices to adjust, creating prices and rents inflation, a phenomenon detected on the French housing aid system (Bozio et al., 2017). Additionally, in this case the welfare gains are captured by landlords, that are concentrated on older agents.

The contribution of this paper is three-fold. First, it expands on the literature on the persistent effects of initial labor market conditions, by proving that existing conditions at the time of graduation can have negative and scarring effects on housing tenure and affordability. So far literature has focused on labor market outcomes, such as individual earnings (Raaum and Røed (2006) Kahn (2010), Genda et al. (2010), Oreopoulos et al. (2012), Kawaguchi and Murao (2014), Brunner and Kuhn (2014), Liu et al. (2016), Cockx and Ghirelli (2016), and Fernández-Kranz and Rodríguez-Planas (2018)). More recently, other variables outside the labor market have been studied, such as health status (Currie and Schwandt (2014), and Maclean and Hill (2015)), mortality (Schwandt and von

Wachter, 2020), and family formation (Currie and Schwandt, 2014). This research builds on Schwandt and Von Wachter (2019), who extend the existing methodology into large cross-sectional data bases and study the effects of initial labor market conditions on career and socioeconomic outcomes such as poverty incidence and health insurance. In this paper, I further extend the analysis to housing outcomes, adding an entire new perspective to the welfare impacts of initial labor market conditions. My results suggest that the consequences of bad initial labor market conditions may have been larger that what previous literature suggested. Additionally, while most studies focus on a one-country case study, my analysis covers 33 EU countries. Moreover, by using cross-sectional data, I am able to study entire cohorts from 1960 to 2018. This allows me to capture in a better way the long-term dynamics behind housing outcomes.

Second, I extend the framework of the OLG models with housing markets. I show that these models not only can be used for analyzing housing allocation, but also they are a useful tool for welfare and policy analysis. In Ortalo-Magné and Rady (2004) the authors use an OLG model to introduce the idea of a housing ladder, in which agents move according to their age and income, from less preferred housing options to more valued ones. In the study by Ortalo-Magne and Rady (2006), authors use an OLG model to show how the ability of young agents to afford down-payment on a starter home can affect the entire housing allocation in the economy. Additionally, authors show a positive correlation between the income of young individuals and housing prices in the economy. In a more recent study, Carozzi (2020) develops an OLG model with no uncertainty and housing quality to relate changes in the composition of housing sales to credit constraint shocks. In his model, younger poorer agents are outbid of home-ownership by wealthier households. Still, all the previous models assume perfect elasticity for prices and rents which may constrain the analysis and may be unrealistic. I contribute to this strand of literature by developing an OLG model to study housing allocation, affordability and welfare. Additionally, I introduce an outside rental option, a feature present in several rental markets. By doing so, I show that the rental market can either absorb or amplify the welfare impact of initial labor market conditions, depending on its rigidity. Additionally, this is the first paper to use these models to perform policy analysis.

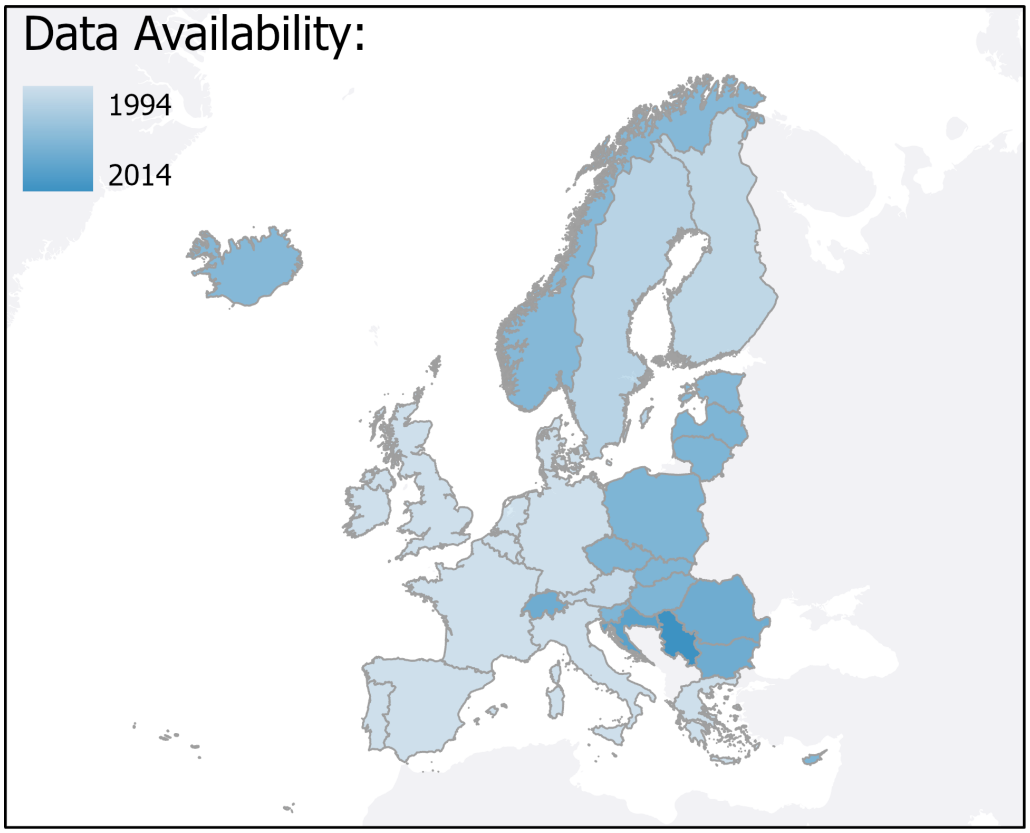
Third, this paper contributes to policy design towards housing markets. I show that housing aid policies can be effective to absorb part of the shock that comes from the labor market. However, if markets are able to adjust to income shocks, then applying a policy of this kind will lead to worse results for the targeted population and to welfare gains concentrating on landlords. This highlights the importance of identifying the correct scenario for applying these policies to ensure that welfare gains benefit the targeted population.

The paper is organized as follows: section 2 focuses on describing the data used, while providing some descriptive statistics, and outlining the empirical strategy; section 3 presents the results of the main specification and some heterogeneous analysis; section 4 provides a stylized version of the housing ladder model, from which a set of propositions is derived, and the welfare and policy analysis is done; and, finally, section 5 presents some concluding remarks.

2 Data and Empirical Strategy

For the purposes of this research I use the micro-data from two major European datasets: the European Union Statistics on Income and Living Conditions (EU-SILC) and the European Community Household Panel (ECHP). The EU-SILC is designed and overseen by Eurostat, and is compulsory for all EU member states. Despite the fact that the survey is carried out by each individual state, Eurostat defines a common framework to ensure a harmonized set of variables. Data collection for these surveys is based on a nationally representative probability sample of the population residing in private households within the country, irrespective of language, nationality and, legal residence status. These surveys cover all private households, and all persons over the age of 16 within the household are potential respondents[2]. Both surveys provide cross-sectional information on various aspects such as income, labor and housing conditions, at both the household and the individual level. Additionally, they also provide longitudinal data so that changes can be measured over a four year period.

Figure 1: Data Availability



Notes: Data availability across European countries. As the ECHP finished in 2001 and the EU-SILC only started in 2004, no data are available for 2002 or 2003.

The ECHP originally covered Belgium, Denmark, Germany, Ireland, Greece, Spain, France, Italy, Luxembourg, the Netherlands, Austria, Portugal, Sweden, and the United Kingdom, from 1994 to 2001. After the survey was discontinued in 2001, it was replaced by the EU-SILC, which covered virtually the same aspects. In addition, the EU-SILC

[2]A more detailed account of the methodology used for EU-SILC can be found in Eurostat (2018) and for ECHP in Eurostat (1996)

gradually included other European nations, and by 2018 the sample included 33 countries. A detailed table showing the countries and data availability is presented in Annex A, and a map of the countries with their incorporation date is depicted in Figure 1.

National-level unemployment is available from the European Central Bank (ECB), and data are generally available from 1960. This is the main data source used to measure labor market conditions at the time of graduation.

2.1 Empirical Strategy

The ideal experiment to study the effect of initial labor market conditions on housing outcomes would be to randomly expose newly graduates to different initial conditions. This would result in a regression:

$$Housing_{i,t} = \alpha + \beta_e initial_{i0} + \gamma_e + \varepsilon_{i,t} \tag{1}$$

In which $Housing_{i,t}$ is the housing outcome of interest, namely whether or not the individual is living in the parental home, at a given time t. $initial_{i0}$ refers to the initial labor market conditions faced by individual i at time 0. Potential years of experience is denoted by e, which is computed as the number of years since graduation; therefore γ_e is potential experience fixed effects. With these fixed effects, β_e captures the potential experience specific deviation from the typical experience profile caused by different initial labor market conditions.

The standard application of Equation 1 has been to compare newly graduates across different labor markets with different unemployment rates, as in Schwandt and Von Wachter (2019) and Oreopoulos et al. (2012). For this analysis I work with a cell-based model in which I collapse the outcome of interest at the country (c), cohort of graduation (g), and calendar year (t). This analysis does not rely on the use of individual-level controls and so it matches the level of variation of the variable of interest, which is cohort-country-year. The baseline specification is as follows:

$$Y_{c,g,t} = \alpha + \beta_e u_{g,c} + \gamma_e + \delta_c + \eta_g + \theta_t + \epsilon_{c,g,t} \tag{2}$$

Where $u_{g,c}$ refers to the unemployment rate of the given country c[3] in a graduation year g. This is the main variable of interest. e refers to potential years of labor market experience[4]. Given the presence of experience, country, cohort, and time fixed effects, and given that there is no control for the current unemployment rate, then β_e captures the effect of an increase in the unemployment rate at the time of graduation, considering the regular subsequent evolution of the national labor market (Schwandt and Von Wachter, 2019)[5]. Errors are clustered at the cohort-country level to account for group-specific correlation. Cells are weighted by their corresponding cell size, to represent population-level estimates.

In line with the reasoning proposed by von Wachter (2020), consider the example in which $Y_{c,g,t}$ is the share of cohort g from country c that is living in the parental home, then γ_e should capture the regular decrease in the share of people living with their parents with years of experience. Then β_e captures the deviation in the share of individuals living

[3]Country refers to the country of current residence.

[4]Potential experience is calculated as calendar year minus graduation year.

[5]For this specification, I present individual coefficients for each of the first 10 years after graduation, but I create a dummy variable for those potential years equal to or greater than 11. This last coefficient should indicate the long term effect of the initial unemployment rate.

with their parents from the regular experience profile at each experience year, and when considered together, the β_e should capture the change in experience profile caused by the initial unemployment rate. Additionally, given the year and country dummies, the variation in each country's unemployment rate consists of changes over time (relative to its own mean, captured by the country-specific coefficient δ_c) that differ from the EU economic cycle (captured by year specific coefficient θ_t). These country-specific cyclical changes in the unemployment rate identify the shifts in the experience profiles caused by bad initial conditions.

The data used for this paper offers an advantage over the previous literature, given that it allows an individual's exact year of graduation to be identified. This helps avoid the use of proxy measures for the year of graduation (such as the Mincerian approach[6]), which increase the probability of measurement errors in highly heterogeneous contexts such as Europe's different educational systems across countries and time. Additionally, working with cross-sectional data provides an opportunity to cover a larger sample than that allowed by traditional longitudinal surveys. This makes it possible to study the long-term effects of initial labor market conditions for cohorts starting as early as 1960 up to 2018.

2.1.1 Potential Threats to Identification

This strategy has two major potential threats. The first refers to endogenous graduation timing. Individuals can potentially shift their graduation according to the labor market conditions at the time of their intended graduation. If this were the case, the estimates would be biased to zero. As shown in Figure B.2 of the Annex, a higher unemployment rate at graduation time increases the probability of being a full-time student for recent low and medium graduates. This indicates that elementary and high school graduates facing harsh economic conditions at graduating are more likely to stay in the education system. However, a higher unemployment rate does not increase the probability that college graduates will continue to study. This indicates that, despite an individual's concerns about the state of the economy at the time of graduation, completing higher education translates into entering the labor market. This threat to identification has been faced by previous studies, and following their strategy is that I restrict the sample study to college graduates (Kahn, 2010).

The second potential threat arises from endogenous migration. If individuals choose to move to avoid the economic conditions in their place of residence when graduating, by assigning their current place of residence as their graduation location, individuals would probably be assigned better economic conditions than those they would have faced. This would lead to an attenuation bias in the results. Endogenous moving has been documented for the US, for example by Wozniak (2010), whereby individuals facing harsh labor market conditions at the time of their graduation in their home state decide to move to another state. However, as shown by Dijkstra and Gakova (2008), while around 2% of the working population moves from one state to another every year in the US, in the EU-27, only 0.14% of the working-age population changed residence to another EU country. Therefore, as cross-national border mobility in the EU is generally low, endogenous migration does not pose a threat to this study.

[6]The Mincerian year of graduation is often calculated as the sum of the year of birth, plus six, plus the years of reported education.

2.2 Sample Restrictions and Descriptive Statistics

Given the above mentioned potential identification concerns, this analysis focuses only on the native population with higher education[7]. Thus, to identify a graduation year and country, I exclude all individuals who were not born in the same country as they were interviewed. Additionally, I exclude those who graduated in the same year as the interview to avoid measurement errors, as many variables are measured with respect to the year prior to the interview.

Table 1 shows summary statistics of the sample for the main variables of interest. I separate the variables into two groups: those relating to housing outcomes and those relating to the labor market. For housing tenure, I consider the living arrangement as a set of three options. These are: (1) living with at least one parent, (2) being a homeowner without any parent present in the household, and (3) being a renter without any parent present[8]. Finally, I also include a measure of affordability to indicate the effort required by a household to meet its housing costs. Affordability is traditionally computed as the ratio between housing costs (either down payment or rent) and the household income. With respect to labor outcomes, I show the employment rate, different measures for earnings at both a personal and household level, the number of hours worked in a week and, a temporary employment indicator.

Table 1 shows that living with parents is much more common among recent graduates compared with the general population. Similarly, newly graduates are less likely to be homeowners or renters. In the labor market, newly graduates have lower incomes and a higher rate temporary employment, despite having higher employment levels than the general population.

[7]Given that educational systems can vary greatly between European countries, I segmented the different possible educational levels into three broad categories. First, the lowest possible educational achievement: primary education and first stage secondary education. Second, higher education including undergraduate studies. Third, all other possible educational achievment, which consisted mainly of second-stage secondary education, and all other professional and technical education. From now on, when referring to college graduates, I will refer to the second group.

[8]In the rest of the paper, "with Parents" indicates the share of the cohort living with at least one parent. When using the term "Homeowner" I mean being a homeowner without any parent in the household. The same is true for the term "Renter". Other living arrangements such as living rent-free represent less than 5% of the total population.

Table 1: Descriptive Statistics for Graduation Cohorts Across Europe

Housing arrangement	Full Sample	By Gender		One year after grad.
		Male	Female	
With parents	0.06	0.07	0.07	0.52
Owner	0.77	0.77	0.77	0.23
Renter	0.12	0.12	0.13	0.21
Affordability	0.17	0.16	0.18	0.20
Labor outcomes				
Employed	0.54	0.56	0.51	0.64
Personal monthly gross income €	1,806	2,148	1,451	1,411
Personal annual net income €	11,714	12,124	9,283	6,633
Household annual net income €	37,842	39,349	36,318	34,744
Average weekly hours worked	21.1	23.4	18.7	24.9
Temporary employment	0.06	0.05	0.07	0.24

Notes: All values are converted to euros and then deflated to harmonic price index (HPI which is calculated by the ECB) with a base year of 2018. Personal annual net income and household annual net income are measured with respect to the year prior to the interview, while personal monthly gross income is measured as current income. Temporary employment represents the share of the cohort working under a temporary contract. Owner represents the share of the cohort living in an owned house without any parent present. Renter represents the share of the cohort living in a rental unit without any parent present. "with Parents" indicates the share of the cohort living with at least one parent. Affordability is calculated as total housing expenses over the household's annual net income.

3 Results

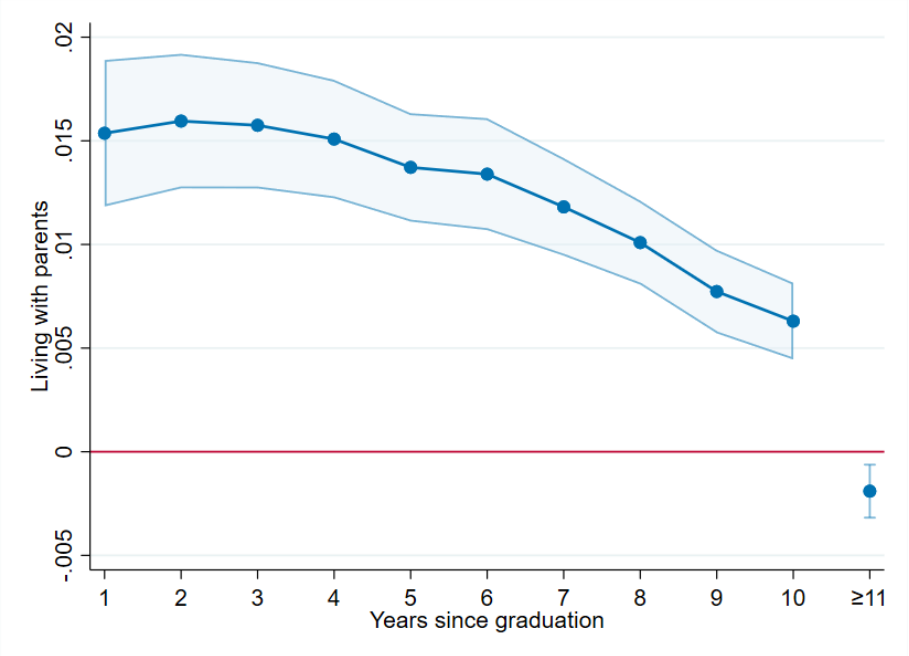
3.1 Housing Market Outcomes

One of the main objectives of this study is to determine whether bad initial economic conditions can have long-term effects on housing tenure and affordability. For the purposes of this study, I will focus on whether individuals live in the parental home (labeled as "with Parents"), live in an owned unit with no parent present (labeled as "Owner"), or live with no parents in a rental unit (labeled as "Renter")[9]. Figure 2 shows the β_e coefficients from Equation 2. These coefficients capture the shift of the share of individuals living with their parents from the typical in the potential experience year profile due to an increase in the unemployment rate at the time of graduation, given the regular subsequent evolution of the labor market[10].

[9] "With parents" is defined as an individual living with at least one person who can be identified as his or her biological, step, adoptive or foster parent, or guardian. "Owner" refers to a person living in a dwelling that is owned by one member of the household, without any parent being present. Households could potentially live in rent-free accommodation, provided by either family or the state, this is not a common situation, especially among young people.

[10] As results are based on the cell model from Equation 2, the coefficients can be interpreted as the share of the cohort living in the parental home, but also as the probability that the individual will live in the parental home

Figure 2: Effect of a one-point increase in the unemployment rate at graduation time on living with parents.



Notes: Effect of a one point increase in the unemployment rate on the probability of living with parents. "With parents" refers to living in a dwelling where at least one parent is present, irrespective of the tenure status. The mean one year after graduation is 52%. Results are based on Equation 2. Data from ECHP and EU-SILC.

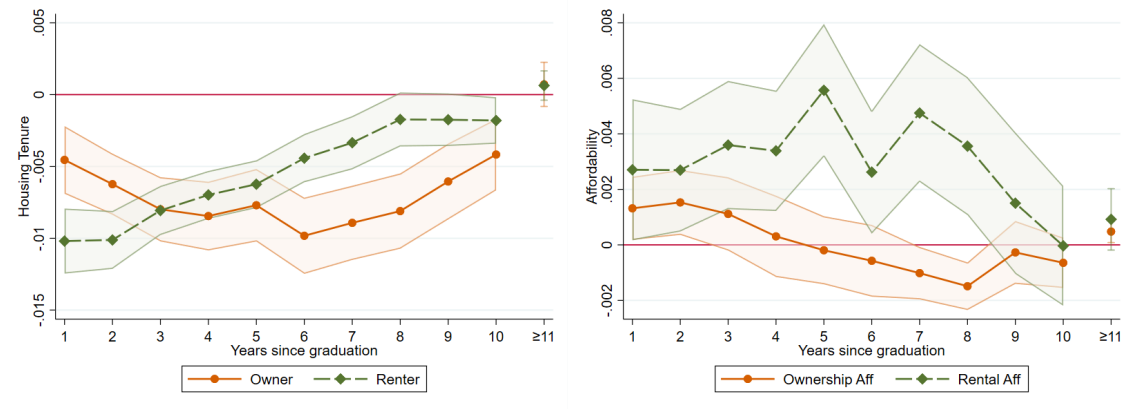
The results indicate that a 1 pp increase at the time of graduation increases the probability of staying in the parental home by 1.5 pp one year after graduation or, when compared to the mean in Table 1, an increase of 2.9%. The effect decreases, but an increase of 1 pp in the unemployment rate at the time of graduation increases the probability of living with the parents by 0.6 pp in the 10th year after graduation. The accumulated effect after ten years is 12.5 pp. Detailed results with the values of the coefficients are presented in Table C.2 of the Annex.

While younger households choose stay at home with their parents, it is necessary to identify which option, i.e., renting or ownership, they are giving up. The results shown in Figure 3a indicate that it is a combination of the two. Worse economic conditions at graduation time lead to a lower probability of renting with no parent present, with the effect being -1.02 pp (-4.9% when compared to the mean) one year after graduation. This effect follows a similar pattern to that of living with parents, with the largest coefficients being immediately after graduation. The effect is no longer significant approximately eight years after graduation.

Finally, while a 1 pp increase in the unemployment rate leads to a lower fraction of homeowners of -0.45 pp in the first year after graduation, it implies a -2.0% decrease with respect to the mean in Table 1, and its effect isstill significant after 10 years. The smaller initial magnitude in owners than in renters could be explained by the fact that the majority of newly graduates do not opt to buy a home immediately after graduation. By contrast, most graduates buy a home some years after graduation, after they have been able to save for a given period of time. This could help explain why the coefficient is stronger approximately six years after graduation. The effect on ownership is interesting

because it points to a different long-term dynamic than in previous literature that has focused on labor outcomes. The results shown here suggest that focusing solely on the years immediately after graduation could lead to an underestimation of the actual impact of initial labor market conditions on given outcomes. The magnitude of the effect on living with parents is approximately the same as the sum of the effect on renters and owners. This indicates that the empirical strategy correctly captures the tenure options of young individuals.

Figure 3: Effect of a one-point increase in the unemployment rate at the time of graduation on housing tenure and affordability.



(a) Tenure status. **(b)** Affordability for owners and renters

Notes: Sub-figure a) depicts the effect of a 1 pp increase in the unemployment rate at the time of graduation on the probability of being an owner and renter. "Owner" refers to living in dwelling owned by one member of the household, without any parent being present. Similarly, "renter" refers to living in a dwelling that is being rented by the household but without any parent present. The mean one year after graduation is 21% for "renter" and 23% for "owner". Sub-figure b) depicts the effect of a 1 pp increase in the unemployment rate at the time of graduation on housing affordability for owners and renters. Affordability is calculated as the yearly housing costs over the household's yearly income. Results are based on Equation 2. Data from EU-SILC.

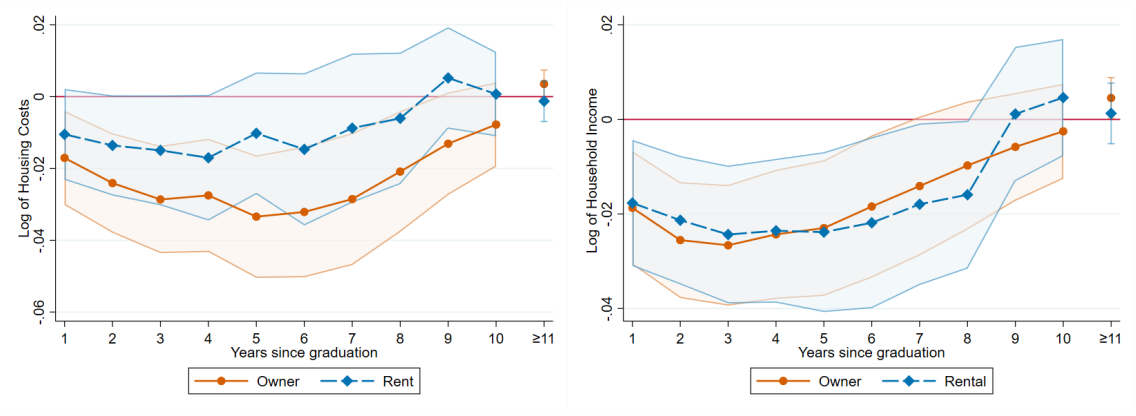
Affordability is commonly computed as the coefficient between yearly housing costs and household yearly income[11]. Therefore, higher levels of this ratio indicate a greater effort by the household to meet its housing living expenses. The results in Figure 3b show that an increase in the unemployment rate at the time of graduation worsens the affordability ratio for both those living in rented accommodation and those living in owned units. The effect is a 0.27 pp increase one year after graduation in the affordability ratio for renters, and a 1.0% increase when compared to the mean. Over a 10 year period, this implies a 3.3 pp increase in the affordability ratio. With respect to affordability for those who own their unit, the effect implies a 0.13 pp increase one year after graduation, a 0.6% increase when compared to the mean, and an accumulated effect of 0.15 pp over a 10 year period.

As mentioned above affordability is calculated as the ratio between rent (or mortgage) paid and household income. Therefore, variation in this ratio could arise from either of these two variables. For example, if one assumes that worse initial labor market conditions lead to lower household income, in the case that rental costs and prices fall in the

[11]Due to data availability, the measure used here is housing costs which include not only the rent or mortgage, but other living costs, such as building insurance, regular maintenance and repairs, utilities (for rental units) and other services and charges. While including these other factors could introduce undesired sources of variation, in any case, rent or mortgage payments constitute the majority of housing costs.

same proportion, the affordability ratio should remain the same. On the other hand, if household income falls but rental costs and prices are somewhat rigid and do not decrease less than income, then this could lead to worse (i.e., higher) affordability ratios. This latter hypothesis seems to be confirmed in Figure 4. The results show that, while the effect on housing costs remains close to zero, there is a negative and significant effect on household income for both owners and renters. These results are in line with those previously reported and indicate that worse affordability arises mainly from a reduction in household income rather than a rise in housing costs.

Figure 4: Effect of a one-point increase in the unemployment rate at graduation time on housing costs and household income.



(a) Log of housing costs

(b) Log of household income

Overall, poor economic conditions at graduation time therefore seem to have a significant effect on young people's housing outcomes. If I consider one standard deviation in the unemployment rate in our sample, i.e., an increase of 4.4 pp in the unemployment rate, then the increase in the share of young graduates living with their parents one year after graduation associated with such deviation is 6.75 pp. Additionally, such a deviation could imply worse affordability ratios for both renters and owners. The magnitude of such effects suggests that a typical recession in the labor market has the potential to affect the housing market through the tenure decision of young people.

3.1.1 Heterogeneity Analysis

Given the different characteristics presented by the sample, it is important to analyze the results for different sub-samples at a time. This provides further evidence on how initial labor conditions can affect individuals. For visualization purposes, I will focus only on the probability of individuals living with their parents[12].

First, as shown in Figure 5, the results differ slightly with respect to the gender dimension. The impacts on living with parents are higher for males and also more persistent in time. While for men, a 1 pp in the unemployment rate at the time of graduation translates into a 1.77 pp increase in the probability of living with parents one year after

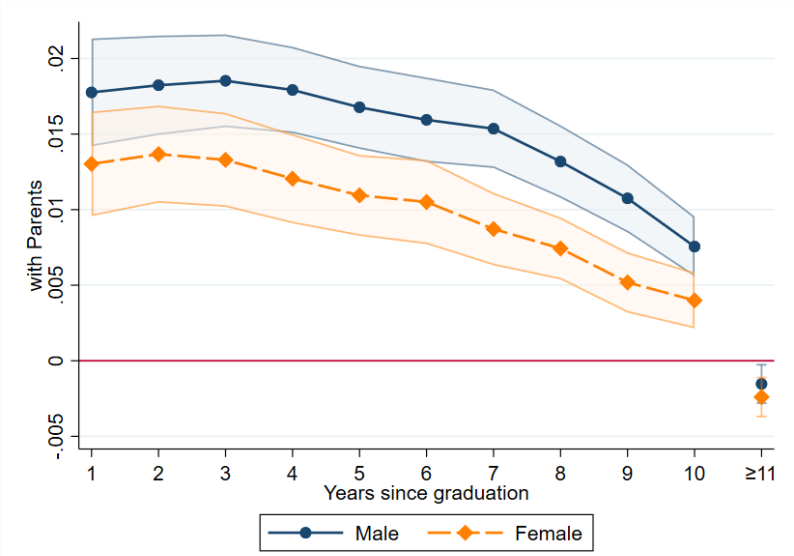
[12]For these results, the equation used is the following:

$$Y_{c,g,t} = \alpha + \beta_e u_{g,c} X + \gamma_e + \delta_c + \eta_g + \theta_t + \epsilon_{c,g,t} \tag{3}$$

Where the only difference with respect to Equation 2, it includes the variable X, which is a dummy variable that takes a value equal to one if the cell corresponds to the group of interest and zero otherwise.

graduation; for women the value is 1.30 pp. While for men the effect with respect to the mean represents a 3.29% increase, this figure is 2.66% for women. The smaller effect on females could be explained by the lower labor force participation rate among women. While 58% of males are employed within the first year after graduation, only 52% of newly graduated women work in the first year after graduation. Since this is a shock in the labor market, female individuals that were not planning to enter the labor market may not be affected by the shock.

Figure 5: Results by gender on probability of living with parents

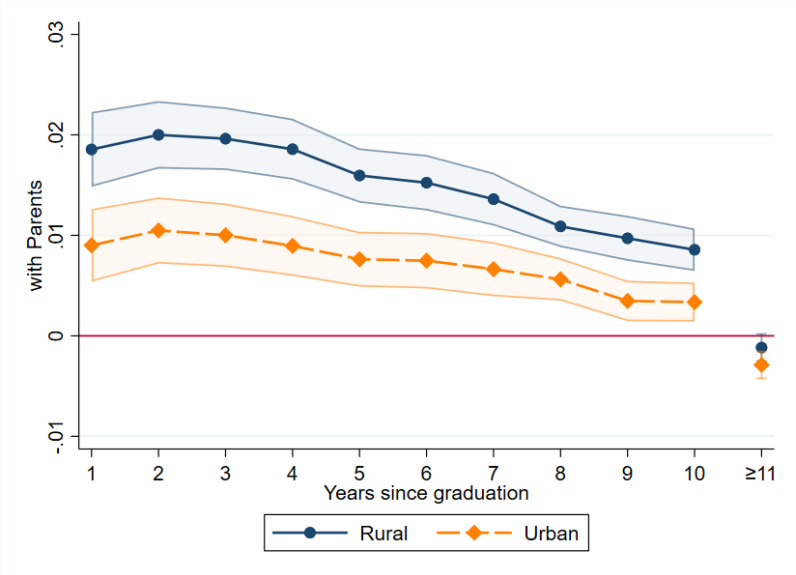


Notes: Effect of a one-point increase in the unemployment rate on the probability of living with parents, understood as living in a dwelling where at least one parent is present, irrespective of the tenure status. Results are based on Equation 3. Data from ECHP and EU-SILC.

As the housing opportunities faced by young people vary dramatically when they live in a city or rural environment, it is also important to shed light on the heterogeneous results in this area[13]. With respect to the effect on the probability of living with parents, it appears that the magnitude on individuals in rural areas is larger than for those in urban. While the effect is 1.85 pp in the case of rural areas, the figure is 0.90 pp in urban settings one year after graduation. The effect when compared to the mean is 3.2% and 1.92%, respectively. Rental markets differ greatly between urban and rural areas; therefore, a potential explanation is that rental markets play a role in how income shocks affect housing tenure.

[13]Due to data availability, this analysis in particular restricts the sample only to countries and years for which data on urban density are available. This excludes all countries before 2005 and particularly the Netherlands throughout the entire sample, and Germany and France for the years 2016, 2017 and 2018.

Figure 6: Results by urban density on probability of living with parents



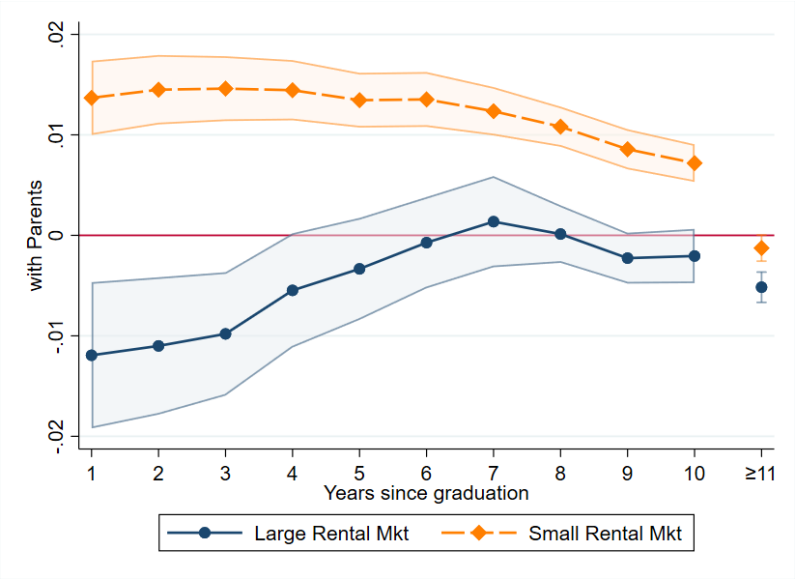
Notes: Effect of a one point increase in the unemployment rate on the probability of living with parents, understood as living in a dwelling where at least one parent is present, irrespective of the tenure status. Results are based on Equation 3. Data from ECHP and EU-SILC.

To analyze whether the size of the rental market plays a role in the results; I split the sample into countries with "large" versus "small" rental markets. I label a country as having "large rental market" if the share of households living in rental units is larger than the EU-27 mean for 2017 (which is equal to 30%), and countries with "small rental market" are those below the median[14]. The results show that the effects for countries with large rental markets are negative, while countries with smaller rental markets drive most of the results.

Rental markets could play a major role in how the shock ends up affecting housing tenure decisions. A potential mechanism is that if the rental market is occupied primarily by young people, then a large market with the ability to adjust to demand shocks should be better at absorbing shocks such as those experienced by newly graduates. This point will be discussed at length in section 4.

[14]The countries with large rental markets are: Austria, Denmark, France, Germany, Ireland, Netherlands, Sweden, Switzerland, and the United Kingdom.

Figure 7: Results by size of rental market on probability of living with parents.



(a) Living with parents

Notes: Effect of a one point increase in the unemployment rate on the probability of living with parents, understood as living in a dwelling where at least one parent is present, irrespective of the tenure status. Results are based on Equation 2. Data from ECHP and EU-SILC.

3.1.2 Robustness

In this section, I test whether the results previously presented are robust to different specifications and measures. First, I test whether using an alternative measure for the national unemployment rate causes any change to the results. As unemployment rates can be calculated based on different criteria across countries, I use estimates for national unemployment rates by the International Labour Organization (ILO), which provides data for all countries in the sample starting from 1991. The ILO unemployment rate should provide a more harmonic measure of unemployment across countries than that of the ECB or national statistics institutes, with the caveat the date only goes back as far as 1991. Figure E.10 in Annex E replicates the main results using the ILO unemployment rate, along with the baseline results. Results show that coefficients obtained using the ILO unemployment rate are not significantly different to locally calculated unemployment rates.

Second, a problem could arise from binning the long-term effect from 11 or more years of potential experience into a single coefficient. Potentially, by binning coefficients, some dynamics that take place in the medium to long-term could be lost. Figure E.9 in Annex E replicates the main results for the main specification using different thresholds for the long-term effects, with individual coefficients up to 20 years after graduation. The results show that the effect persists over time, with each new coefficient being closer to zero than the one before. This suggests that the effect does indeed tend to fade over time.

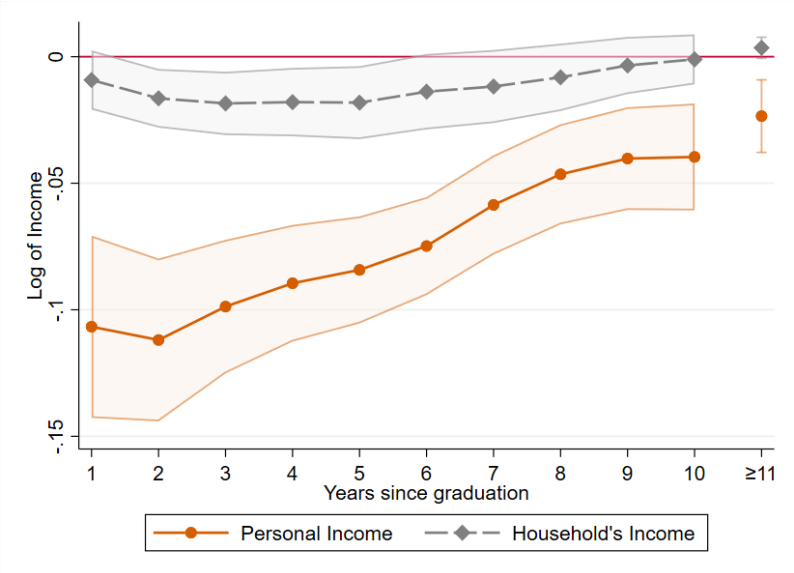
Third, I also test for different model specifications. I control for country-year fixed effects. The graphs are depicted in Figure E.11 in Annex E. The results show that there is no statistically significant difference between the baseline equation and with year-country fixed effects added.

3.2 Additional Outcomes

3.2.1 Labor Market Outcomes

Using graduation time as exogenous, I study the effect of the initial labor market conditions at graduation time on various outcomes later in life. Figure 8 shows the coefficients of β_e for each experience year. As shown, an increase in the unemployment rate at the time of graduation has a negative impact on both personal as on household earnings.

Figure 8: Effect of a one-point increase in the unemployment rate at graduation time on annual earnings and household income.



Notes: Effect of a one-point increase in the unemployment rate on the log annual personal earnings, and net household income, both measured in the previous year. Results are based on Equation 2. Data from ECHP and EU-SILC.

The results indicate that a rise in unemployment at the time of graduation leads to lower personal earnings; specifically, a 1 pp increase in the unemployment rate at graduation time leads to an 11% decrease in personal earnings in the first year after graduating. While this effect fades over time, it is still present 10 years after graduation. The results indicate that the accumulative effect of a 1 pp increase in the unemployment rate at graduation on earnings after 10 years is about 38% of average annual earnings. It is important to note that, as the surveys capture all individuals, and not only those that entered the labor market, then the effect also captures those individuals who did not enter the labor market, as well as those with longer spells of unemployment.

Concerning previous studies, the estimates are somewhat larger. The most similar study, given that it uses several cohorts is Schwandt and Von Wachter (2019), who found that a 1 pp increase in the unemployment rate leads to a loss of 3.8% in earnings during the first three years after graduation, although these estimates are increased slightly once they control for endogenous graduation timing. For Oreopoulos et al. (2012) the effect of a 3 pp increase in the unemployment rate leads to a 6% loss in earning during the first year after graduation. However, Kahn (2010) found that a 1 pp increase in the regional unemployment rate leads to a 9.2% loss in annual earnings. Despite this, it is important to state that context of these studies differs significantly from mine, since these papers focused on North America, and in the case of Oreopoulos et al. (2012) and Kahn (2010) on

male college graduates only. Additionally, this paper deals with the world crisis in 2008, which could potentially have had a larger effect than previous recessions.

The data allows me to study the causes behind this drop in personal income. The results show that an increase in the unemployment rate at the time of graduation leads to a lower probability of being employed in the years following graduation. A 1 pp increase in the unemployment rate at the time of graduation leads to 1.2 pp decrease in the probability of being employed in the first year after graduation. With respect to those who are working, they have a higher probability of being employed under a temporary contract rather that a permanent one. A 1 pp increase in the unemployment rate at graduation time leads to a 0.9 pp increase in the probability of being employed under a temporary contract in the first year, which implies an increase of 3.7% when compared to the mean. Additionally, for those who were working at the time of the interview, being exposed to a higher unemployment rate leads to lower labor intensity, with individuals working fewer hours per week. In this case, a 1 pp increase in the unemployment rate leads to a 4.5% decrease in the average number of hours worked per week.

In terms of the impact on household income, the magnitude of the effect is much smaller than on personal income, with a decrease of 0.9% in the first year after graduation for every 1 pp increase in the unemployment rate at the time of graduation. This difference between the personal and household effect can be partially explained by the results presented in the previous section. This attenuation could potentially occur because household income also captures parental income if the individuals have not moved. If individuals choose to stay in the parental home, and parents are not affected to the same extent as newly graduates by an increase in the unemployment rate, then the household income will have a lower effect than personal income. In this case, the results are similar in magnitude to those of Schwandt and Von Wachter (2019), with a 1.0% reduction in the household income one year after graduation for each 1 pp increase in the unemployment rate the previous year. Table C.3 in the Annex presents the results in detail, and shows the coefficients for different potential experience years.

3.2.2 Mediation Analysis

The results so far have shown that bad initial labor market conditions lead to a higher probability that an individual will live in the parental home, and have a lower personal income. However, it is important to verify that the effect on living with one's parents is actually caused by the lower income or whether it is another simultaneous effect derived from poor initial conditions. To answer this question, I perform a mediation analysis.

Mediation analysis is often used to determine the mechanisms behind the relationship between a treatment and its outcome. The idea is to identify an "indirect effect" that operates through a mediator variable, and a "direct effect" that takes account of the other mechanisms. If the effect of the treatment variable works entirely through the mediator, it is called full mediation. Mediation analysis has been used extensively across the social sciences. In economics, some recent examples can be found in Huber (2015), whose authors used this method of analysis to study the mechanisms behind the decrease in the gender wage gap in the US. A key point in mediation analysis is to ensure that the indirect effect is statistically significant. A valid strategy is to use bootstrapping as pointed out by Memon et al. (2018).

Application to this study would help clarify the mechanisms by which the unemploy-

ment level at the time of graduation affects housing outcomes. In this case, the mediation variable is the individual's income.[15] The results shown in Figure D.8 in the Annex suggest the, in the first few years after graduation almost the totality of the effect on the probability of living with parents is explained by the income effect. In the first few years after graduation, the direct effect is not statistically different from zero, which means that the total effect and the indirect effect to have very similar coefficients. These results point to the fact that the effects of bad initial labor market condition are mostly the result of an income channel in the first few years after graduation.

3.2.3 Other Outcomes: Housing Aid, Family Formation, and Health Status

There are ways in which a younger household can decide to cope with the shock and still be able to leave the parental home. A potential strategy is to rely on external economic aid to meet housing costs. This aid can come from the parents or the government through special housing aid. I now explore these two possibilities.

I study whether young households that leave the parental home after graduating in worse economic conditions receive larger amounts of money from another household. The results indicate that a higher unemployment rate at the time of graduation leads to an increase in the amount received from another household when not living in the parental home. For those living in the parental home, the effect is the opposite. This suggests that, while some individuals still decide to leave the parental home, they can do so by receiving regular money from the parental household. In particular, a 1 pp increase in the unemployment rate at the time of graduation increases the amount received from another household by 3.5%. This effect is statistically significant up to seven years after graduation. For households that leave the parental home, an increase in the unemployment rate also increases the amount of housing allowance received from the government. The effect is a 0.6% increase in the amount received in housing allowances from the government although this is not statistically significant. The results are shown in Figure C.7 in the Annex.

These results concerning housing aid are broadly in line with the duration of the effects of the unemployment rate at the time of graduation on the probability of renting and being a homeowner, with the effect on renting becoming statistically insignificant eight years after graduation and the effect on being a homeowner reaching its lowest negative value six years after graduation. This suggests that parental households assist their adult children with housing costs until their peers living with parents leave the parental home.

So far, the literature has focused on the effects of initial labor market conditions on several career outcomes. However, the results presented here have shown that graduating at a bad time can lead to worse outcomes in housing tenure and affordability. These results show that the welfare impacts of initial labor market conditions can be underestimated if one considers only labor market outcomes. In this subsection, I provide some results in other areas that corroborate the idea of greater welfare impacts.

[15] In the context of this research this translates into Equation 4.

$$\begin{aligned} Parents_{c,g,t} &= \alpha + \beta_e u_{g,c} + \kappa_e inc_{g,c} + \gamma_e + \delta_c + \eta_g + \theta_t + \epsilon_{c,g,t} \\ inc_{c,g,t} &= \mu + \pi_e u_{g,c} + \rho_e + \sigma_c + \tau_g + \upsilon_t + \epsilon_{c,g,t} \end{aligned} \tag{4}$$

Following the benchmark approach proposed by Sobel (1982), the indirect effect of income on on individual staying with parents is equal to the product of κ_e and π_e. The direct effect of unemployment at the time of graduation on living with one's parents is given by the coefficient β_e. Figure D.8 shows the coefficients of applying Equation 4 to the data set.

Initial unemployment conditions can impact other outcomes that are also correlated with housing tenure and can affect individual welfare. A clear example of this is family formation. The results in Figure C.5 in the Annex show that worse economic conditions at graduation time lead to a lower probability of being in a relationship. This is true when considering not only formal marital relationships, but also consensual unions and cohabitation with a partner. Overall, individuals are less likely to form part of a couple (whether formal or not) when the unemployment rate is higher at the time of graduation. A potential consequence of not being in a relationship is delayed parenthood. The results indicate that a higher unemployment rate at the time of graduation reduces the probability of being a parent. These results concerning family formation are significant even 10 years after graduation. While the coefficient indicates that a 1 pp increase in the unemployment rate at the time of graduation decreases the probability of becoming a parent by approximately 0.9 pp one year after graduation, the effect is 5.5% when compared to the mean. The accumulated effect over 10 years is a reduction of approximately 11 pp. These results are broadly in line with previous literature that found a negative relationship between the unemployment rate at the time of graduation and childbearing and marriage. Detailed results are presented in Figure C.5 and Table C.3 in the Annex.

As initial unemployment conditions can have an impact on important outcomes such as income, housing tenure, and family formation, it is possible that they also affect an individual's health. Overall, initial unemployment conditions do not seem to have a significant impact on an individual's health. Concretely, an increase in the unemployment rate at the time of graduation does not affect the probability that individuals will declare their health status as "bad" or "very bad". Moreover, the unemployment rate at the time of graduation does not have a significant effect on the probability of suffering from chronic illness, being limited in one's daily activity due to their health, or having unmet medical examination needs in the last year. Detailed results are presented in Figure C.6 and Table C.5 in the Annex. These results are in line with previous literature as in the case of Cutler et al. (2015), who found that graduating during periods of high unemployment in Europe does not have a significant effect on health outcomes for individuals with at least 10 years of education. With respect to previous studies on the US, Schwandt and Von Wachter (2019) found that college graduates do not experience a reduction in health insurance coverage as a result of graduating during bad period.

While this research focuses on college graduates only, section F of the Annex, presents the results for all educational levels.

4 A Stylized Model

4.1 Set up

In this section, I present a stylized version of the model. I focus on the impact that a negative income shock to young agents has on housing consumption and affordability, showing the pivotal role that an outside rental option can have on the outcome. A full version of this model can be found on section G in the Annex.

Agents are born with no wealth but are heterogeneous in their income and live for three periods. Let $e_a(i)$ be the endowment at age $a \in (1, 2, 3)$ of type $i \in [0, 1]$, such that $e_a(i) \to \mathbb{R}^+$ is continuous and increasing, and $e_1(i) = \psi e_2(i)$ where $\psi \in (0, 1)$. Only for this stylized model I will assume a uniform distribution of agents income.

Agents receive utility from the consumption of a numeraire good and from their housing tenure choices. Agents prefer ownership over renting and renting over living with parents[16]. There is a utility discount β and an interest rate r, and I assume that $\beta(1+r) \geq 1$. These assumptions will imply that agents consume no housing in period three as in Carozzi (2020) so the maximum housing demand is equal to 2.

Agents can choose between three tenure options: live with their parents, rent and own. The housing stock for ownership is fixed $\overline{\mathrm{S}}$, and $\overline{\mathrm{S}} < 2$, so no all agents can rent or own a unit, and therefore some are forced to live with parents[17].

The supply of rental units comes from landlord agents, who own more than one unit and live in one while renting out the other. I introduce an outside option for rental units, which works as a price floor in the rental market. This feature has been documented in several ways: as the possibility of renting out to tourists (Garcia-López et al., 2020), a reserve value of leaving the accommodation empty (Segú, 2020), or converting housing into offices (Beauregard, 2005). Landlords decide to rent to younger households as long as they can afford to pay at least the outside rental option, otherwise they opt for the outside option.

Prices are depicted as p_t, which are prices for housing at time t, and R_t is the rent paid in advance at time t. In order to own a unit, individuals can borrow an amount γp_t, as long as they have the initial down-payment $(1-\gamma)p_t$. I impose a restriction whereby a household can only have one mortgage at a time. Additionally, I assume $r < min[\gamma, 1-\gamma]$ so that households can always pay their debt in the steady state and there is no default.[18]

In the long term, both rental and ownership markets must be in equilibrium. In the rental market, the supply of rental units from landlords must be equal to the sum of the units demanded from older agents, young agents and, (if applicable) the outside option. Similarly, the fixed supply of owned units ($\overline{S}$), must be equal to the sum of the demand for owned units from older agents, young agents, and the supply of rental units.

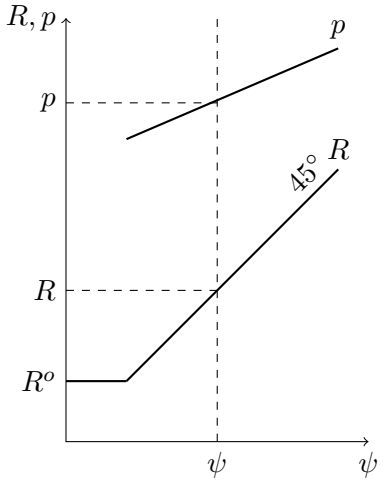
In the steady state it is possible to determine some boundaries for housing prices and rents. For rents, it is possible to show that $R = e_1(2 - S^o)$, which implies that rent is determined solely by young agents' income. For prices, it is possible to establish a lower bound: $p \geq e_1(2-S^o)(1-\gamma)^{-1}$. In this case, housing prices are related both to young and old agents income. This points that while rents are fully linked to young agent's income, ownership prices are not. A diagram of how this boundaries works with respect to young agents' income is depicted in Figure 9.

[16]More formally, let U_{c_t,h_t} be the household's utility, which can be expressed as $U_{c_t,h_t} = c_t + u_h(\tau_t)$ where c_t is the consumption of the numeraire good, and $u_h(\tau_t)$ the residential choice at time t. Agents living with their parents receive zero utility from housing, while agents living in an owned unit receive the maximum utility v_o. Agents in rental units receive uv_o utility from housing, and as $u < 1$ then the utility from renting is lower that of being owner.

[17]Setting ψ low enough is enough to ensure that only young agents live with their parents.

[18]Additionally, there is no guarantee of $rp = R$ in equilibrium as there are no deep pocketed investors.

Figure 9: Rents, prices and young agents' income in the steady state

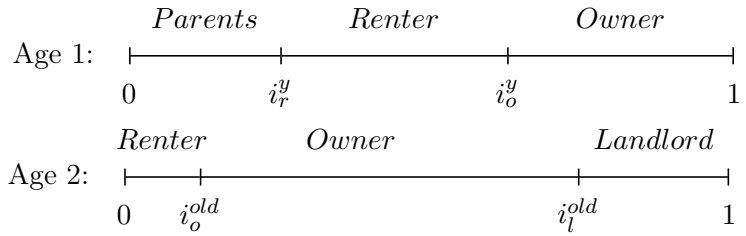


Notes: This figure depicts the steady state prices and rents for different levels of young agents' income (ψ). While rents are on the 45 degree line, prices have a lower slope, thus indicating that changes in ψ lead to proportional changes in rents but not in prices. When ψ is low enough, rent in steady state is equal to the outside option value.

4.2 Allocation and Affordability

I define thresholds in the type distribution of agents that determine the distribution of households across units. For young agents, the relevant thresholds are i_r^y and i_o^y, which indicate the thresholds young agents can afford to rent and own. For old agents the relevant thresholds are i_r^{old} and i_l^{old}. These indicate the points at which old agents can afford to own and to be landlords (i.e., own a unit and rent out the other). Therefore, for young households we can identify the share of agents living with their parents as i_r^y, the share of agents in rental units as $i_o^y - i_r^y$, and the share of agents in owned units as $1 - i_o^y$. The position of these thresholds depends entirely on the model parameters. They can be depicted as following:

Figure 10: Steady state allocations



Notes: This figure depicts the steady state allocations for young and old individuals, arranged by income. For higher income levels agents locate in their more preferred housing tenure choice, such as home-ownership. Only young agents face the possibility of living with their parents.

Agents pay different amounts with respect to each housing tenure choice. In particular they pay zero when living with parents, R when renting, and $p(1-\gamma)$ when they own their homes. This defines their affordability ratio for young agents as φ^h where $h \in [p, r, o]$ for those living with parents, renting, and homeowners respectively. As housing costs remain constant within the tenure options, agents differ in their affordability ratio according to their income.

The marginal renter is the individual who can barely afford to rent, spending all of its income on rent, thus having an affordability ratio equal to one. As income increases the affordability ratio decreases, up to the wealthiest renter, who pays the same price for the rental unit as the marginal renter but has a highest income. The wealthiest renter has the lowest affordability ratio, as the price paid for the housing unit takes up the least amount of income. The average affordability ratio for rental agents is the average of the affordability ratios between the marginal renter and the wealthiest renter. It is also possible to define the average affordability for renters as the average between the affordability of the marginal and the wealthiest renter. This provides an index measure to reveal how affordability changes between housing tenure groups. The same analogous can be said for young owners.

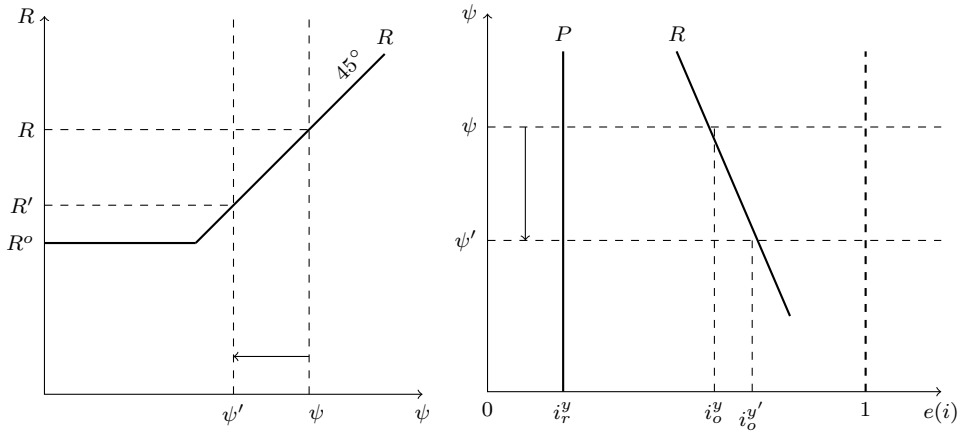
4.3 Propositions

In this section I analyze the impact of a negative income shock on young individuals, depicted as a permanent decrease in ψ. I focus on two scenarios: one in which the rental markets has downward flexibility, which means that the outside rental option plays no role, and the other with downward flexibility in the rental markets, which implies that the outside option functions as a price floor.

4.3.1 Case 1: Flexible Rental Markets

If the rental markets are flexible, then a decrease in the income of young agents should cause a proportional decrease in rents. This is due to the fact that as young agents are the only marginal renters, the rent level will follow the marginal renters' income, to keep housing markets in equilibrium. This dynamic is depicted in Figure 11a.

Figure 11: Effect of a negative income shock on housing allocation and affordability in a flexible rental market.



(a) A shock in a flexible rental market **(b)** Housing allocation in steady state

Notes: The figure on the left shows the effect on equilibrium rent for a negative shock in income for young households (depicted by ψ). In this case the shock is translated into a proportional drop in rents, thus making steady state rent flexible. The figure on the right shows the housing allocation for young households in steady state, according to different income levels for young households (depicted by ψ). Both figures depict a scenario in which there is a uniform distribution of agents' income.

Figure 11b shows the steady state housing allocations for young households for dif-

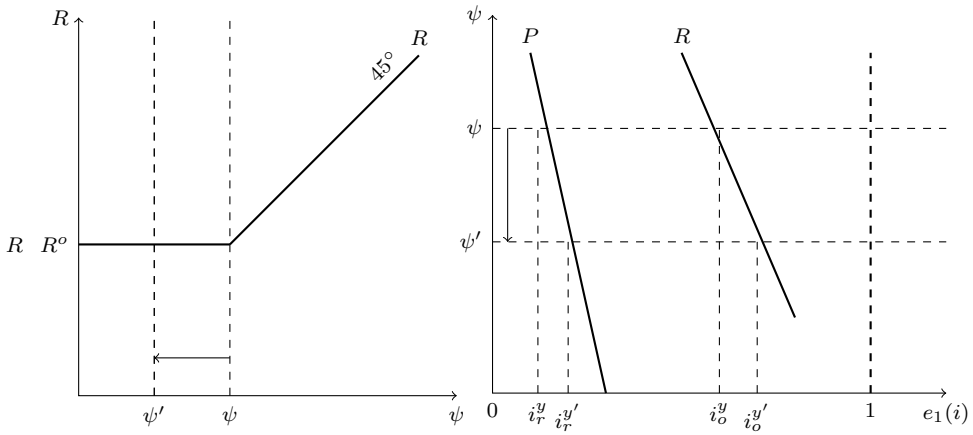
ferent levels of ψ. When ψ lowers, young agents are poorer in relation to older agents. This means that they will settle for the least preferred housing options, as they are outbid by older, wealthier households. Since rents adjust perfectly to the young agent's new income in this case, the share of young agents living with their parents, depicted by i_r, will remain the same. However, as prices do not adjust fully to the new income of young agents, some of them will no longer be able to afford to become a homeowner. In this case, there will be a group of agents that were owners with the previous allocations, but are now renters, thus making the total share of young agents living in rental units increase (this is depicted by the shift from i_o to i'_o). In this way, the number of housing units consumed by agents in equilibrium remains the same.

The shock will affect young renters' average affordability. While the marginal renter (i.e., between living with parents and renting) will still spend all of its income on rent, the new wealthiest renter will spend less of its income on housing costs. This is because the wealthiest renter is now an agent who otherwise would have been a homeowner. Even though the income of this agent falls, the price paid for housing consumption shifted from an owned unit to a rental one. Paying for an owned unit is always more expensive than paying for a rental one, thereby making its affordability ratio drop. In this way, the average affordability ratio for renters also drops.

4.3.2 Case 2: Rigid Rental Markets

If rental markets are rigid, meaning that the outside option works as a price floor in the rental market, then a drop in income for young individuals will not cause a proportional fall in rental prices. It could even be the case that rental markets are fully rigid, meaning that rents will not respond to a drop in young agents' income. This case is depicted in Figure 12a.

Figure 12: Effect of a negative income shock on housing allocation and affordability in a rigid rental market.



(a) A shock in a rigid rental market **(b)** Housing allocation in steady state

Notes: The figure on the left shows the effect on equilibrium rent for a negative shock in income for young households (depicted by ψ). In this case the initial equilibrium rent is already equal to the outside option rent, making that the steady state rent to be fully rigid. The figure on the right shows the housing allocation for young households in steady state, according to different levels of income for young households (depicted by ψ). Both figures depict a scenario in which there is a uniform income distribution on agents income.

As a direct consequence of this rigidity in the rental market, the share of agents living with their parents is no longer fixed. This dynamic is presented in Figure 12b. When faced with a negative income shock, a group of agents living in rental units will see their incomes drop but their housing costs (in this case rental costs) remain unchanged, thus making renting unaffordable. A negative income shock therefore leads to a steady-state with more agents living with their parents, with a shift from i_r to i'_r. Housing markets remain in equilibrium as landlords receive R^o from the outside option, which keeps the rental option attractive for landlords. As in the previous case, prices do not fully capitalize the shock in young agents' income, meaning that some will not longer be able to afford to own and will opt to rent.

Again, the shock will affect young renters' average affordability, but in the opposite direction to the previous case, thereby leading to worse (i.e., higher) average affordability for young renters. The marginal renter will spend all of its income. However, it is possible to prove that the wealthiest renter will see a decrease in its income in excess of the drop in the amount spent on housing (as rents are now more rigid than prices), thereby increasing its affordability ratio. As marginal renter' affordability remains the same, but the wealthiest renter' affordability increases, then the average affordability for renters will increase.

Overall, the results presented in section 3 seem to be in line with the second scenario provided here. A negative income shock, such as that caused by bad initial labor market conditions, leads to a higher share of individuals living with their parents, as well as higher affordability ratios for renters and owners. This would suggest that rental markets have downward rigidity, and that renting to young people is not as attractive as other rental options.

4.4 Welfare

The model can be numerically solved to provide some insight into several areas. The full model, along with its calibration and numerical solution are shown in section G of the Annex. The first task is to study the welfare impacts of the above-mentioned income shock on agents. To that end, I develop a measure of welfare at the cohort level that takes account of both the utility derived from housing allocation and the utility derived from low affordability ratios[19].

Using the calibration shown in detail in section G.1 of the Annex, it is possible to show that housing welfare in young agents decreases when there is a negative income shock. In line with the predictions shown in the previous section, welfare decreases more for young agents when rental markets are rigid. In particular an income loss of 33% for young agents will imply a 11% decrease in welfare in flexible rental markets while a 39% when rental market are rigid.

The higher welfare loss experience by young agents in rigid rental market scenarios is because, in this scenario, more young agents are pushed to live with their parents (and

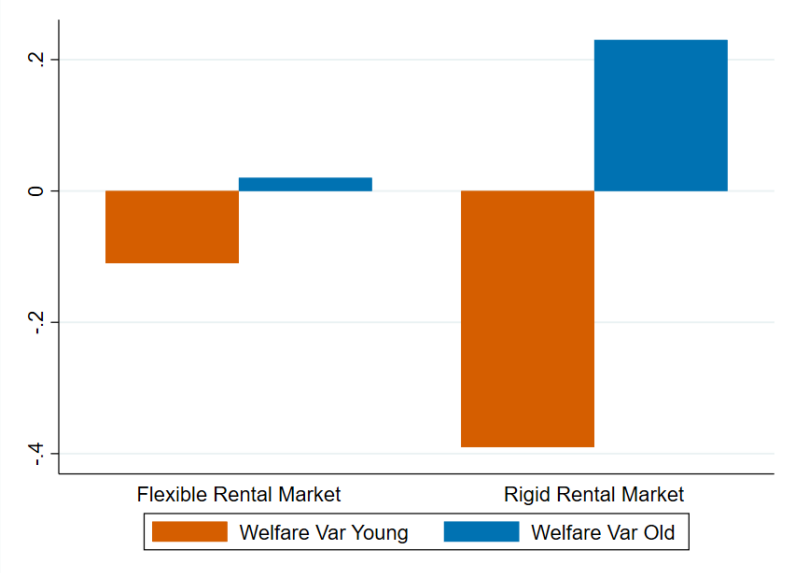
[19]In particular, I compute welfare as the sum of an individual's welfare with age a:

$$W_a = \sum_i \frac{u_{h,i}}{\mu * v_o} * 0.75 - \varphi_i * 0.25$$

Where W_a represents welfare for cohort age a. $u_{h,i}$ is the housing utility as defined in the model derived from the housing option normalized to the rental utility and φ_i represents the affordability ratio for individual i. The index is set to reflect agents' decision-making in the model, but also to capture the negative impact of having a high affordability ratio. The index will have values of between zero and two.

therefore receive no utility) and owners and renters have higher affordability ratios. Welfare losses in the case of flexible rental markets are minimized, as housing allocation shifts less towards the least preferred options, and affordability ratios are not greatly affected. For older households, welfare is almost not affected when a shock occurs in a flexible rental market scenario. However, when the rental markets are rigid and a negative income shock to young agents occurs, then older agents' welfare will increase significantly. This is because older agents have more capacity to outbid younger agents in the housing market, since they are wealthier in absolute terms but now also in relative terms to housing. These results are depicted in Figure 13.

Figure 13: Effect of a negative income shock on welfare agents, in flexible and rigid rental market.



Notes: Figure illustrates losses in welfare derived from a negative income shock to individuals. Parameters are based on the calibration in section G.1.

4.5 Policy Analysis

The model's numerical solution also allows a policy analysis to be carried out. Consider the case of housing aid in France. This is an interesting case, as almost one in every three French households receive a housing allowance, one of the highest rates in the OECD. Additionally, these allowances account for a large part of government spending, given that it accounted for 0.72% of national GDP, the fourth highest expenditure in the OECD (OECD, 2018). On average, households receive 30% of their housing expenditure, with 90% living in rental units (Hananel and Richet-Mastain, 2019). In the model, I translated this policy into one in which 30% of the poorest agents receive housing aid equivalent to 30% of the rental market price and called it APL *(Aide Personnalisée au Logement)*, the name of France's the largest housing aid program.

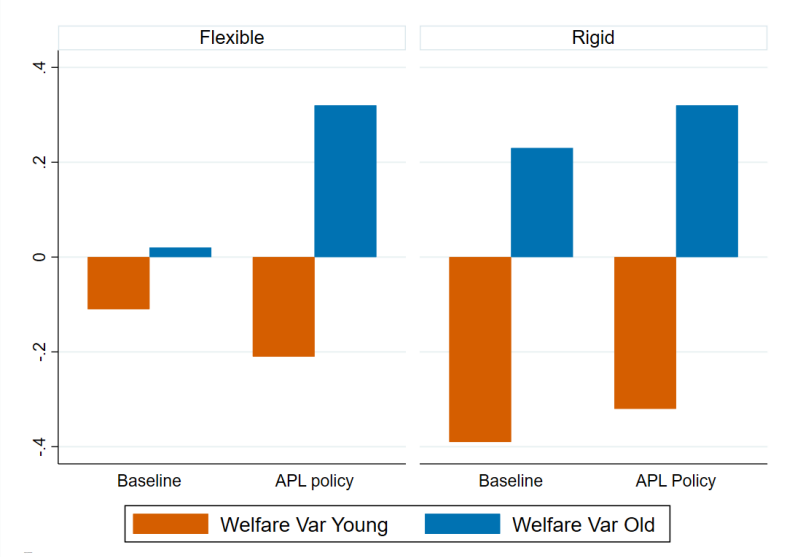
The results shown in Figure 14 indicate that these types of policies are effective when it comes to alleviating the welfare impact of a negative income shock in rigid rental markets. In particular, when young agents suffer a 33% income loss, the welfare loss in rigid rental markets is of 39%, while when implementing a APL-style of policy, welfare losses are reduced by 7 pp. As young agents have lower incomes than older agents, they will

be the beneficiaries of this policy, which, has the capacity to diminish the welfare impact of a negative income shock. The mechanism through which this policy operates is by increasing young agents' income and making it competitive with the outside rental option. This decreases the number of agents who would otherwise be living with their parents. Additionally, it improves the affordability of renters, since it increase their income.

However, when implementing this policy in a flexible market scenario, the policy actually causes a drop in young agents welfare. This is because prices and rents do not adjust, but the policy is not large enough to cover all individuals that suffer an income loss. This provokes that some agents suffer both an income loss and unchanging rental costs, pushing them closer to a situation of rigid rental markets. This rents and prices rigidity introduced by this policy in this scenario, worsens affordability ratios for some young agents. Welfare for older agents improves, as they capture the rigidity in rents, as well as being relatively wealthier than young individuals. Thus, applying a housing aid policy in a flexible rental market scenario makes young agents worse off than not implementing any policy.

This analysis shows that policies aimed at the housing market can help recover part of the lost welfare due to a labor market shock, as it helps young agents access ownership and rental units, and lowers the share of young agents living with their parents. However, for the policy to improve young agents welfare, the policy must be implemented in the right scenario.

Figure 14: Welfare effects in a rigid rental market when an APL-style policy is applied.



Notes: Figure depicts the welfare change of a negative income shock, when applying no policy (baseline) and when applying an APL-style of policy when there is a negative income shock to young agents in both flexible and rigid markets. Parameters are based on the calibration on section G.1.

5 Concluding Remarks

In this paper, I estimated the long-term effects of an increase in the unemployment rate at graduation time on housing tenure and affordability. I did this for a large sample of college graduates since 1960 across Europe. I exploited the unemployment rate at the time of college graduation as an exogenous income shock to the individual. This strategy

has been explored extensively for career outcomes, but so far not for housing tenure and affordability. These two outcomes are important, as they are key determinants of an individual's welfare.

The results show that a 1 pp increase in the unemployment rate at the time of graduation leads to a 1.50 pp increase in the probability of living with parents. Additionally, it lowers the probability of home-ownership by 1.02 pp and renting by 0.45 pp. Worse conditions when graduating also worsen affordability ratios for owners and renters, with the effect caused by lower incomes and unchanging housing costs. All of these effects are persistent over time. This shock also leads to lasting effects on personal earnings, with the magnitude larger than previously reported in the literature. In line with the previous literature, the effect is non-significant in health status when restricting to college graduates. However, initial labor market conditions do have a significant effect on family formation, with individuals less likely to be in a relationship and, become parents.

Using an overlapping generation model with housing markets, I am able to replicate recent trends in the housing market, and link these changes to income shocks for younger generations. The stylized model is a simple exercise that produces several results. Mainly, that the rental markets' rigidity can greatly determine whether the welfare shock from the labor market is absorbed or amplified by the housing market. Rental market rigidity can be a result of an outside option for landlords, a feature widely documented in the literature. In particular, if rental markets are rigid, an income shock to young agents will create a shift away from renting and ownership in favor of the parental home, as the shock works through quantities rather than prices and rents. Additionally, this shock impacts housing affordability, worsening affordability for both renters and owners, as their income drops but housing costs do not.

Finally, I addressed the question whether these shifts in housing tenure affect agents' welfare and what policies can be used to mitigate the shock. To answer this question, I numerically solve the model and find that a rigid rental market leads to more acute welfare losses then flexible rental markets. Additionally, I find that housing aid policies such as the *Aide Personnalisée au Logement* (APL) in France can help mitigate the shock by enabling young agents to afford renting. However, these policies only improve young agents welfare when implemented in rigid rental markets, pointing towards the importance of identifying the correct conditions for the application of these policies.

References

Beauregard, R. A. (2005): "The textures of property markets: downtown housing and office conversions in New York City," *Urban Studies*, 42, 2431–2445.

Bozio, A., M. Guillot, M. Monnet, and L. Romanello (2017): "Designing housing benefits: An application with French data," *Economie prevision*, 163–175.

Brunner, B. and A. Kuhn (2014): "The impact of labor market entry conditions on initial job assignment and wages," *Journal of Population Economics*, 27, 705–738.

Carozzi, F. (2020): "Credit constraints and the composition of housing sales. Farewell to first-time buyers?" *Journal of the European Economic Association*, 18, 1196–1237.

Cockx, B. and C. Ghirelli (2016): "Scars of recessions in a rigid labor market," *Labour Economics*, 41, 162–176.

Currie, J. and H. Schwandt (2014): "Short-and long-term effects of unemployment on fertility," *Proceedings of the National Academy of Sciences*, 111, 14734–14739.

Cutler, D. M., W. Huang, and A. Lleras-Muney (2015): "When does education matter? The protective effect of education for cohorts graduating in bad times," *Social Science & Medicine*, 127, 63–73.

Dijkstra, L. and Z. Gakova (2008): *Labour mobility between the regions of the EU-27 and a comparison with the USA*, EU.

Eurostat (1996): *The European Community Household Panel (ECHP).: Volume 1. Survey Methodology and Implementation*, Office for official publications of the European Communities.

——— (2018): "Methodological Guidelines and Description of EU-SILC Target Variables 2017." Tech. rep.

Fernández-Kranz, D. and N. Rodríguez-Planas (2018): "The Perfect Storm: Graduating during a Recession in a Segmented Labor Market," *ILR Review*, 71, 492–524.

French, D. and D. McKillop (2017): "The impact of debt and financial stress on health in Northern Irish households," *Journal of European Social Policy*, 27, 458–473.

Fry, F., J. Passel, and D. Cohn (2020): "A majority of young adults in the US live with their parents for the first time since the Great Depression. Washington, DC: Pew Research Center; 2020," .

Fuller-Tyszkiewicz, D. L. H.-C., D. Hutchinson, C. Olsson, G. Tooley, and B. Crotty (2016): "Australian Unity Wellbeing Index Survey 33.0," .

Garcia-López, M.-À., J. Jofre-Monseny, R. Martínez-Mazza, and M. Segú (2020): "Do short-term rental platforms affect housing markets? Evidence from Airbnb in Barcelona," *Journal of Urban Economics*, 103278.

Genda, Y., A. Kondo, and S. Ohta (2010): "Long-term effects of a recession at labor market entry in Japan and the United States," *Journal of Human resources*, 45, 157–196.

Hananel, J. and L. Richet-Mastain (2019): "Les bénéficiaires d'aides au logement: profils et conditions de vie," .

Huber, M. (2015): "Causal pitfalls in the decomposition of wage gaps," *Journal of Business & Economic Statistics*, 33, 179–191.

Judge, L. and D. Tomlinson (2018): "Home improvements: Action to address the housing challenges faced by young people," *Available on the Internet: https://www. resolutionfoundation. org/app/uploads/2018/04/Home-improvements. pdf.*

Kahn, L. B. (2010): "The long-term labor market consequences of graduating from college in a bad economy," *Labour Economics*, 17, 303–316.

Kawaguchi, D. and T. Murao (2014): "Labor-Market Institutions and Long-Term Effects of Youth Unemployment," *Journal of Money, Credit and Banking*, 46, 95–116.

Lang, V. W. (2015): "Coresidence and Parent-Adult Child Closeness and Conflict: The Influence of Social Class, Parenting Strategies and Economic Efficacy," Ph.D. thesis, Bowling Green State University.

Liu, K., K. G. Salvanes, and E. Ø. Sørensen (2016): "Good skills in bad times: Cyclical skill mismatch and the long-term effects of graduating in a recession," *European Economic Review*, 84, 3–17.

Maclean, J. C. and T. D. Hill (2015): "Leaving school in an economic downturn and self-esteem across early and middle adulthood," *Labour Economics*, 37, 1–12.

Memon, M. A., J. Cheah, T. Ramayah, H. Ting, and F. Chuah (2018): "Mediation analysis issues and recommendations," *Journal of Applied Structural Equation Modeling*, 2, 1–9.

Netemeyer, R. G., D. Warmath, D. Fernandes, and J. G. Lynch Jr (2018): "How am I doing? Perceived financial well-being, its potential antecedents, and its relation to overall well-being," *Journal of Consumer Research*, 45, 68–89.

Oreopoulos, P., T. Von Wachter, and A. Heisz (2012): "The short-and long-term career effects of graduating in a recession," *American Economic Journal: Applied Economics*, 4, 1–29.

Ortalo-Magné, F. and S. Rady (2004): "Housing transactions and macroeconomic fluctuations: a case study of England and Wales," *Journal of Housing Economics*, 13, 287–303.

Ortalo-Magne, F. and S. Rady (2006): "Housing market dynamics: On the contribution of income shocks and credit constraints," *The Review of Economic Studies*, 73, 459–485.

Parker, K. (2012): "The boomerang generation: Feeling ok about living with mom and dad," *Pew Research Center, Social and Demographic Trends*, 6.

Raaum, O. and K. Røed (2006): "Do business cycle conditions at the time of labor market entry affect future employment prospects?" *The review of economics and statistics*, 88, 193–210.

Schwandt, H. and T. Von Wachter (2019): "Unlucky cohorts: Estimating the long-term effects of entering the labor market in a recession in large cross-sectional data sets," *Journal of Labor Economics*, 37, S161–S198.

Schwandt, H. and T. M. von Wachter (2020): "Socioeconomic decline and death: Midlife impacts of graduating in a recession," Tech. rep., National Bureau of Economic Research.

Schwanitz, K. and C. H. Mulder (2015): "Living arrangements of young adults in Europe," *Comparative Population Studies*, 40.

Segú, M. (2020): "The impact of taxing vacancy on housing markets: Evidence from France," *Journal of Public Economics*, 185, 104079.

Sobel, M. E. (1982): "Asymptotic confidence intervals for indirect effects in structural equation models," *Sociological methodology*, 13, 290–312.

Tosi, M. (2020): "Boomerang Kids and Parents' Well-Being: Adaptation, Stressors, and Social Norms," *European Sociological Review*, 36, 460–473.

Vásquez-Vera, H., L. Palència, I. Magna, C. Mena, J. Neira, and C. Borrell (2017): "The threat of home eviction and its effects on health through the equity lens: a systematic review," *Social science & medicine*, 175, 199–208.

von Wachter, T. (2020): "The Persistent Effects of Initial Labor Market Conditions for Young Adults and Their Sources," *Journal of Economic Perspectives*, 34, 168–94.

Wozniak, A. (2010): "Are college graduates more responsive to distant labor market opportunities?" *Journal of Human Resources*, 45, 944–970.

appendix

A Data Availability in detail

Figure A.1: Data Availability

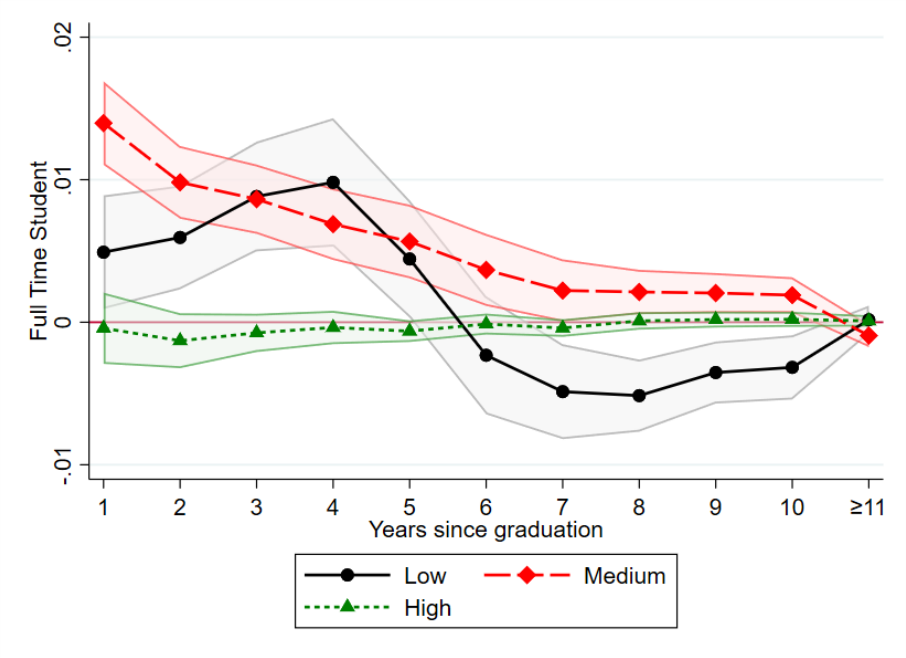
Year	ECHP								EU-SILC														
	1994	1995	1996	1997	1998	1999	2000	2001	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
AT	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BG	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X
CH	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X
CY	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CZ	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DE	X	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DK	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
EE	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
EL	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ES	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
FI	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
FR	X	X	X	X	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X
HU	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X
IE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-
IS	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	-	-
IT	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LT	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LU	X	X	X	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LV	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MT	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	-	
NL	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X
NO	-	-	-	-	-	-	-	-	X	-	X	X	X	X	X	X	X	X	X	X	X	X	X
PL	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X
PT	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
RO	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X
RS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X
SE	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SI	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SK	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	-
UK	X	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X	X	X	-

B Potential Endogeneity

The specification in Equation2 treats the entering in the labor market, determined by the time of graduation as exogenous. However, individuals may decide to extend their education so to avoid unfavorable labor market conditions. This potential endogeneity would attenuate the results toward zero. If additionally there is selection into timing, then the bias could go either way.

The following graph shows the probability of self defining as a student given the unemployment rate at the graduation time of the last educational level attained.

Figure B.2: Effect of a one-point increase in Unemployment Rate at graduation time on being a student.



As expected the effect is negligible in college graduates and stronger for medium education level individuals.

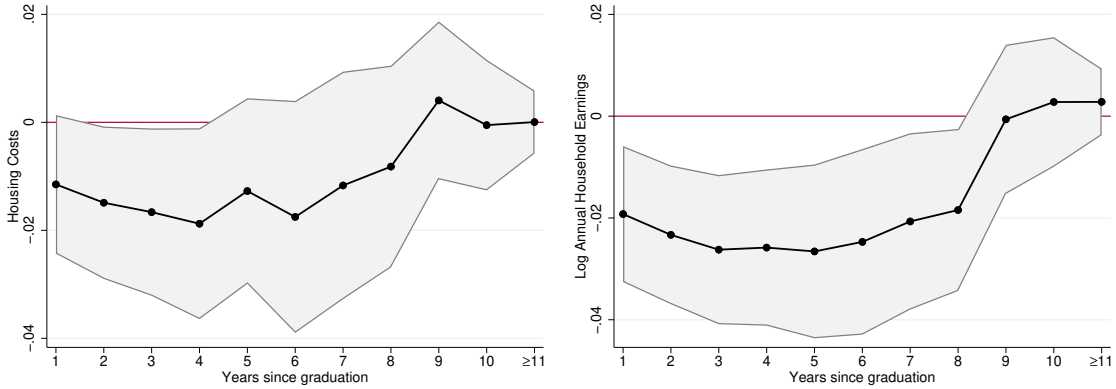
C Detailed Results

Table C.2: Effect of a one-point increase in Unemployment Rate on Housing outcomes

Potential & Experience	With Parents	Owner	Renter
1	0.015***	-0.005***	-0.010***
	(0.002)	(0.001)	(0.001)
2	0.016***	-0.006***	-0.010***
	(0.002)	(0.001)	(0.001)
3	0.016***	-0.008***	-0.008***
	(0.002)	(0.001)	(0.001)
4	0.015***	-0.008***	-0.007***
	(0.001)	(0.001)	(0.001)
5	0.014***	-0.008***	-0.006***
	(0.001)	(0.001)	(0.001)
6	0.013***	-0.010***	-0.004***
	(0.001)	(0.001)	(0.001)
7	0.012***	-0.009***	-0.003***
	(0.001)	(0.001)	(0.001)
8	0.010***	-0.008***	-0.002*
	(0.001)	(0.001)	(0.001)
9	0.008***	-0.006***	-0.002*
	(0.001)	(0.001)	(0.001)
10	0.006***	-0.004***	-0.002**
	(0.001)	(0.001)	(0.001)
11	-0.002***	0.001	0.001
	(0.001)	(0.001)	(0.001)
Constant	0.085***	0.736***	0.149***
	(0.004)	(0.005)	(0.003)
Observations	18,157	18,157	18,157

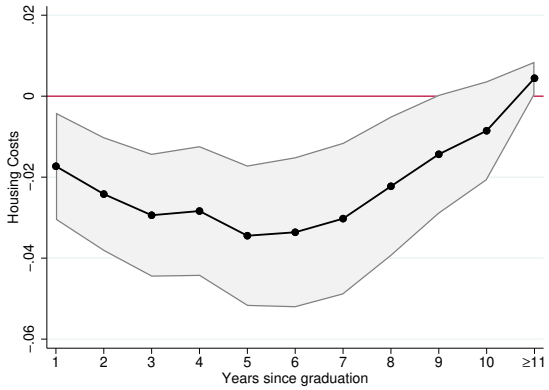
Notes: Significance is indicated by * p<0.1, ** p<0.05, and *** p<0.01. Standard errors, in parentheses, are clustered at the cohort-region level. Effect of a one point increase in the unemployment rate on housing outcomes. Results are based on Equation 2. Data from ECHP and EU-SILC.

Figure C.3: Effect of a one-point increase in Unemployment Rate at graduation time on housing affordability.

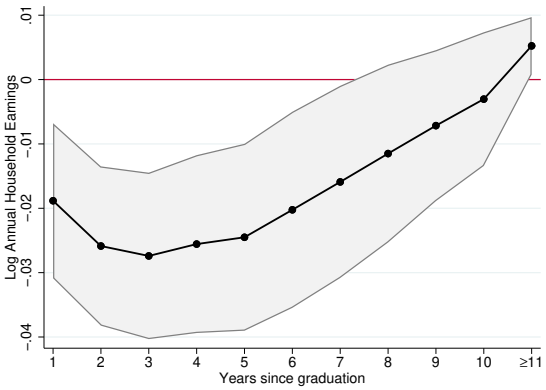


(a) Log of Housing Costs for Renters

(b) Log of Household's Income for Renters



(c) Log of Housing Costs for Owners



(d) Log of Household's Income for Owners

Notes: Effect of a one point increase in the unemployment rate on various housing affordability. Affordability is calculated as the yearly housing costs over the household's yearly income. Results are based on Equation 2. Data from EU-SILC.

Table C.3: Effect of a one-point increase in Unemployment Rate on labor outcomes

Potential & Experience	Log Personal Earnings	Log Households Earnings	Working	Temporary Employment
1	-0.107***	-0.009	-0.012***	0.009***
	(0.018)	(0.006)	(0.001)	(0.002)
2	-0.112***	-0.016***	-0.010***	0.010***
	(0.016)	(0.006)	(0.001)	(0.001)
3	-0.099***	-0.018***	-0.008***	0.010***
	(0.013)	(0.006)	(0.001)	(0.001)
4	-0.090***	-0.018***	-0.007***	0.007***
	(0.012)	(0.007)	(0.001)	(0.001)
5	-0.084***	-0.018**	-0.007***	0.006***
	(0.011)	(0.007)	(0.001)	(0.001)
6	-0.075***	-0.014*	-0.005***	0.005***
	(0.010)	(0.008)	(0.001)	(0.001)
7	-0.059***	-0.012	-0.006***	0.005***
	(0.010)	(0.007)	(0.001)	(0.001)
8	-0.046***	-0.008	-0.005***	0.004***
	(0.010)	(0.007)	(0.001)	(0.001)
9	-0.040***	-0.003	-0.004***	0.004***
	(0.010)	(0.006)	(0.001)	(0.001)
10	-0.040***	-0.001	-0.004***	0.003***
	(0.011)	(0.005)	(0.001)	(0.001)
11	-0.023***	0.004*	-0.003***	0.001
	(0.007)	(0.002)	(0.001)	(0.000)
Constant	7.073***	10.130***	0.757***	0.041***
	(0.045)	(0.013)	(0.004)	(0.004)
Observations	13,554	18,092	18,157	17,288

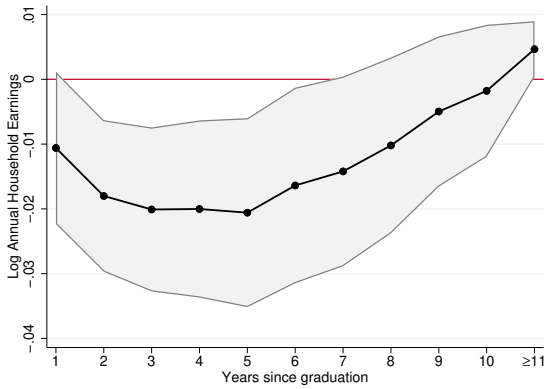
Notes: Significance is indicated by * p<0.1, ** p<0.05, and *** p<0.01. Standard errors, in parentheses, are clustered at the cohort-region level. Effect of a one point increase in the unemployment rate on annual personal earnings. Results are based on Equation 2. Data from ECHP and EU-SILC.

Table C.3: Effect of a one-point increase in Unemployment Rate on Family Formation outcomes

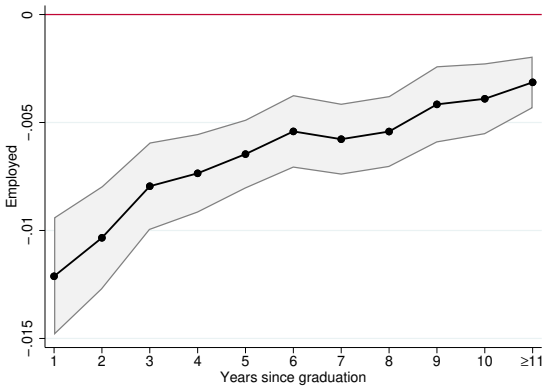
Potential & Experience	Consensual Union	Married	Being a Parent	Cohabitation
1	-0.007***	-0.004***	-0.009***	-0.011***
	(0.002)	(0.001)	(0.001)	(0.001)
3	-0.007***	-0.006***	-0.011***	-0.013***
	(0.001)	(0.001)	(0.001)	(0.001)
5	-0.006***	-0.005***	-0.011***	-0.011***
	(0.001)	(0.001)	(0.002)	(0.001)
7	-0.007***	-0.005***	-0.012***	-0.010***
	(0.001)	(0.001)	(0.002)	(0.001)
10	-0.005***	-0.004***	-0.009***	-0.006***
	(0.002)	(0.001)	(0.002)	(0.001)
11	0.004***	0.001	0.001	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
Observations	17,232	17,549	17,549	17,545

Notes: Significance is indicated by * p<0.1, ** p<0.05, and *** p<0.01. Standard errors, in parentheses, are clustered at the cohort-region level. Effect of a one point increase in the unemployment rate on Family Formation outcomes. Results are based on Equation 2. Data from ECHP and EU-SILC.

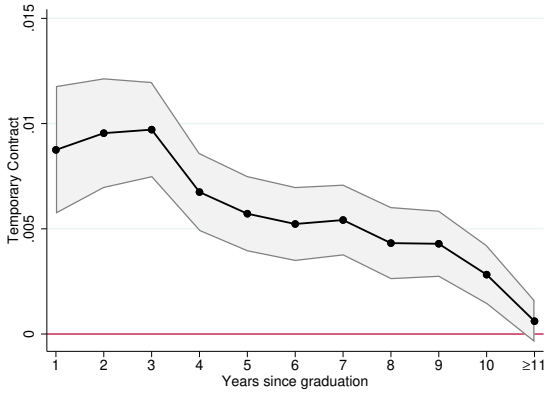
Figure C.4: Effect of a one-point increase in Unemployment Rate at graduation time on Net Household Income, Unemployment Months, Temporary Employment and Weekly Hours Worked.



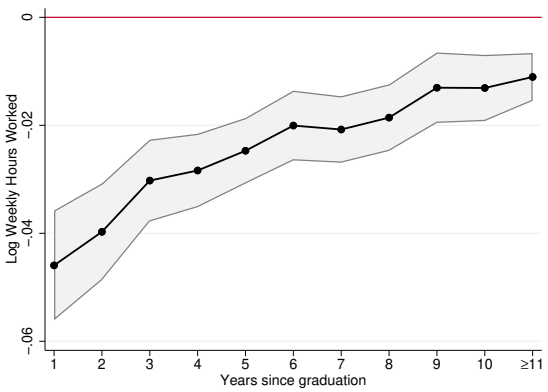
(a) Net Household Income



(b) Employed



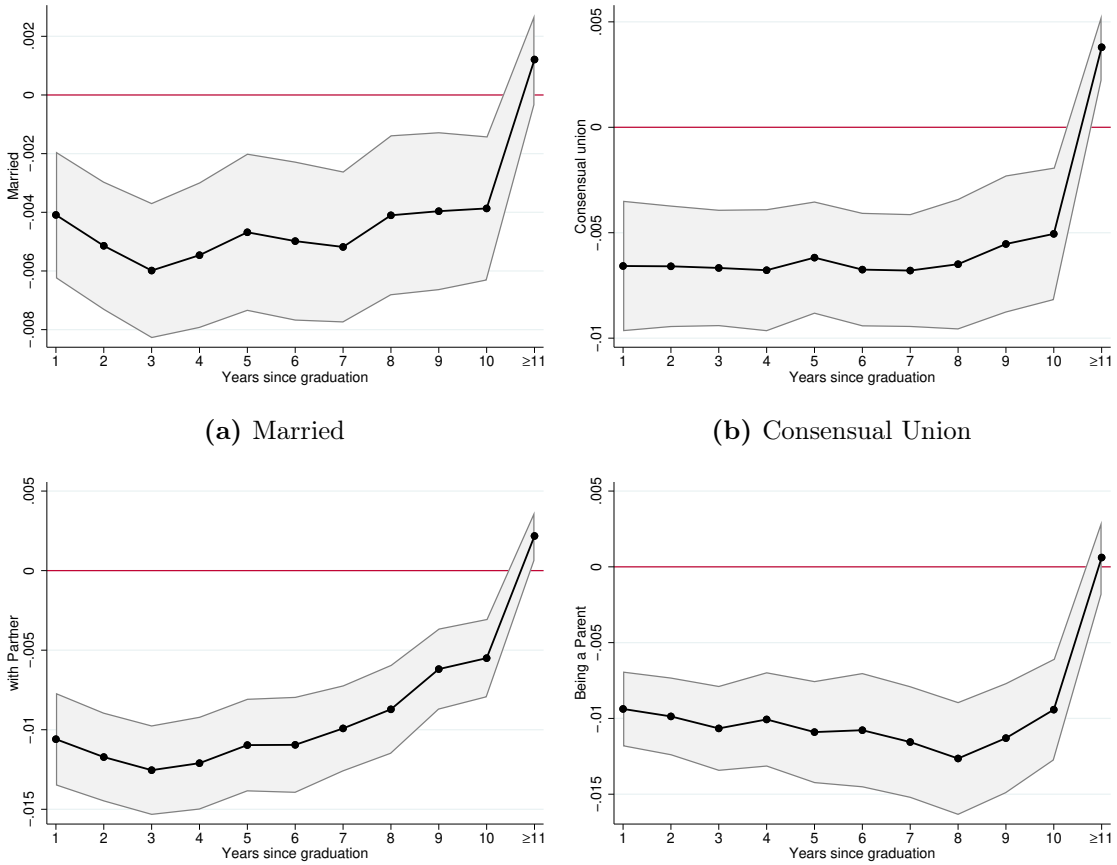
(c) UR Temporary Employment



(d) Log Weekly Hours Worked

Notes: Effect of a one point increase in the unemployment rate on various labor outcomes. Unemployment Moths refers to the number of months during last year that the individual classified herself as "unemployed", temporary employment refers to the type of contract in which the individual is in, which can be fixed or temporary. Weekly Hours Worked refers to the average number of hours worked by week, if the individual is not working then the number is equal to zero. Results are based on Equation 2. Data from ECHP and EU-SILC.

Figure C.5: Results for Family Formation Outcomes



(a) Married

(b) Consensual Union

(c) Living with Partner

(d) Being a Parent

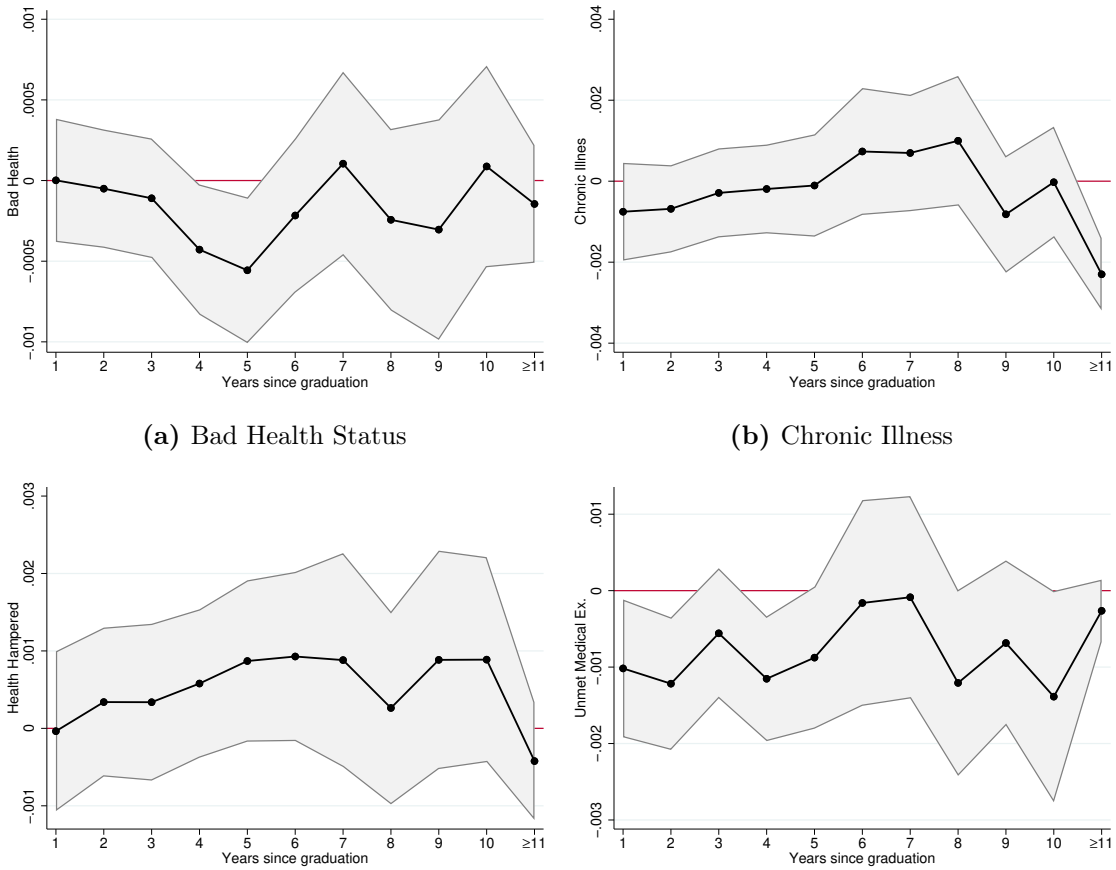
Notes: Effect of a one point increase in the unemployment rate at the time of graduation on various outcomes. Married refers to whether the individual is married on a legal basis or not. Consensual union refers to whether the individual is living a consensual union, with or without legal basis. Living with Partner refers to whether there is a cohabitation status with their partner for the ECHP, or whether the individual's partner is a part of the household for EU-SILC. Being a Parent refers to whether the individual can be identified as "own" / step / adopted / foster parent or guardian of another member of the household. Results are based on Equation 2. Data from ECHP and EU-SILC.

Table C.5: Effect of a one-point increase in Unemployment Rate on Health outcomes

Potential & Experience	Bad Health Status	Chronic Illness	Health Hampered	Unmet Medical Examinations
1	0.000	-0.001	-0.000	-0.001**
	(0.000)	(0.001)	(0.001)	(0.000)
3	-0.000	-0.000	0.000	-0.001
	(0.000)	(0.001)	(0.001)	(0.000)
5	-0.001**	-0.000	0.001	-0.001*
	(0.000)	(0.001)	(0.001)	(0.000)
7	0.000	0.001	0.001	-0.000
	(0.000)	(0.001)	(0.001)	(0.001)
10	0.000	-0.000	0.001	-0.001**
	(0.000)	(0.001)	(0.001)	(0.001)
11	-0.000	-0.002***	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	17,529	17,188	17,529	14,338

Notes: Significance is indicated by * p<0.1, ** p<0.05, and *** p<0.01. Standard errors, in parentheses, are clustered at the cohort-region level. Effect of a one point increase in the unemployment rate on Family Formation outcomes. Results are based on Equation 2. Data from ECHP and EU-SILC.

Figure C.6: Results for Health Outcomes



(a) Bad Health Status

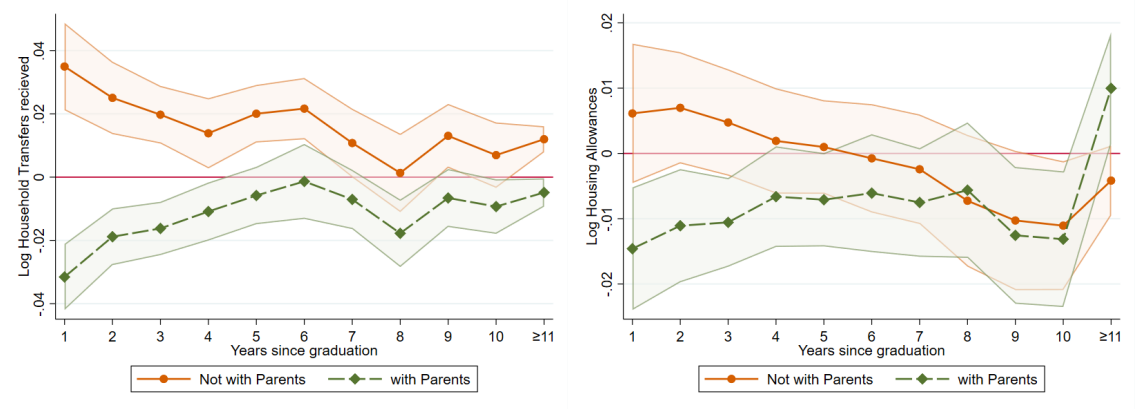
(b) Chronic Illness

(c) Limitation due to health.

(d) Unmet Medical Examination

Notes: Effect of a one point increase in the unemployment rate at the time of graduation on various health outcomes. Bad health status refers to whether the person self perceives her health status as "Bad" or "Very Bad". Chronic illness refers to whether the individuals declares having any chronic illness. Limitation due to health refers to if the person declares having any sort of limitation in their daily activity due to their health. Unmet Medical examination refers to whether the person declares not being able to meet a needed medical examination in the last year. Results are based on Equation 2. Data from ECHP and EU-SILC, except for Unmet Medical Examination which is only available for the EU-SILC base.

Figure C.7: Effect of a one-point increase in Unemployment Rate at graduation time on household's sources of income.

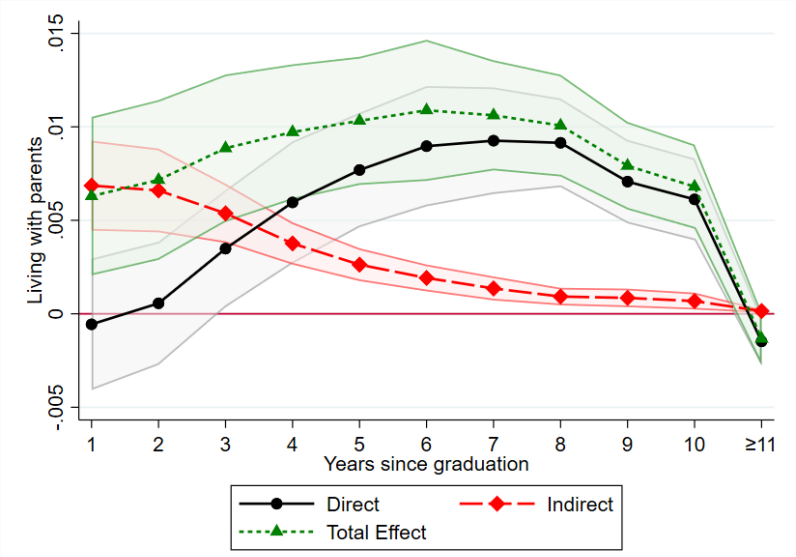


(a) Log of Transfers from another Household **(b)** Log of Governmental Housing Allowances

Notes: Effect of a one point increase in the unemployment rate on various housing affordability. Affordability is calculated as the yearly housing costs over the household's yearly income. Results are based on Equation 2. Data from EU-SILC.

D Mediation

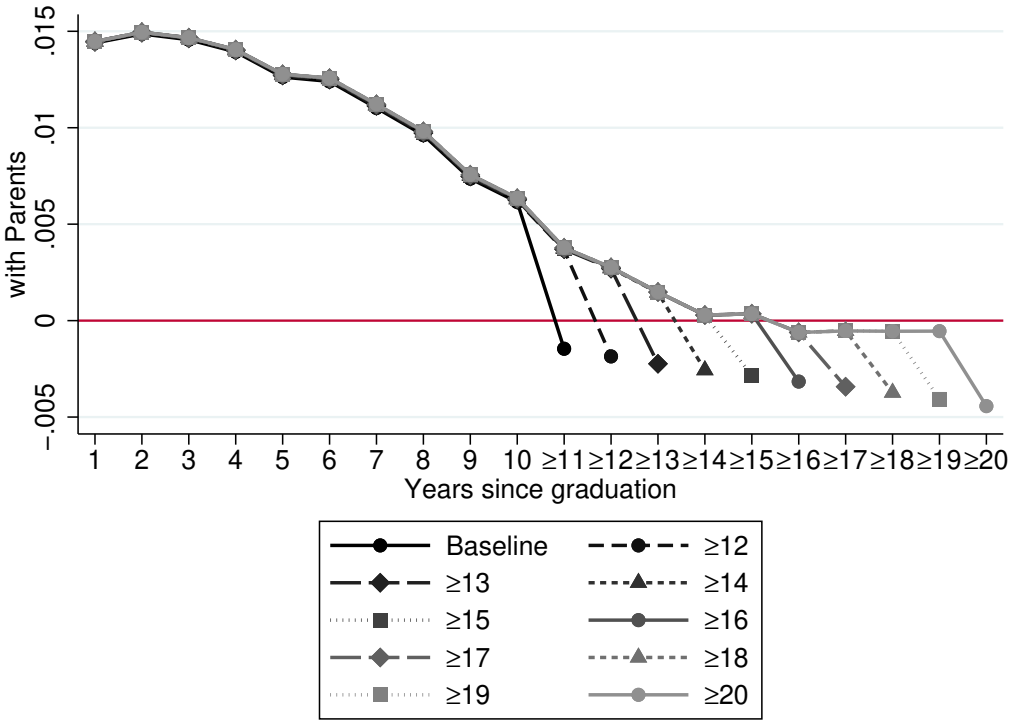
Figure D.8: Mediation of personal income on living with parents



Notes: Effect of a one point increase in the unemployment rate on living with parents using a as a mediator personal income. Standard errors are bootstrapped. Data from ECHP and EU-SILC.

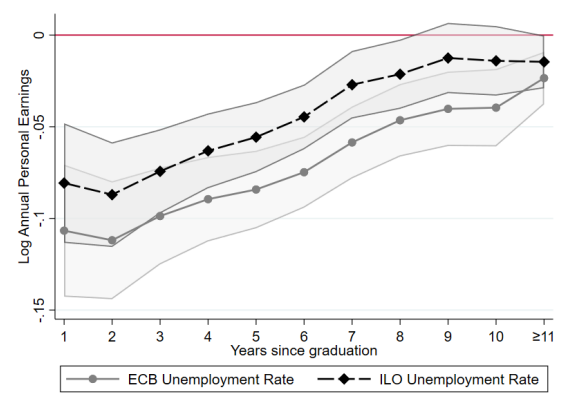
E Robustness

Figure E.9: Effect of a one point increase in the unemployment rate on living with parents, using different thresholds.

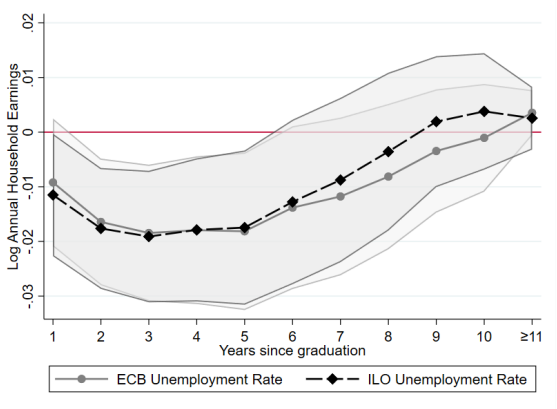


Notes: Effect of a one point increase in the unemployment rate on probability of living with parents. Results are based on Equation 2. Data from ECHP and EU-SILC.

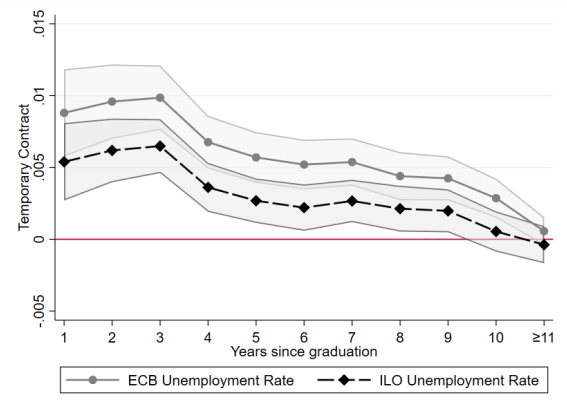
Figure E.10: Effect of a one-point increase in Unemployment Rate at graduation time on various outcomes using ECB and ILO Unemplyment Rates.



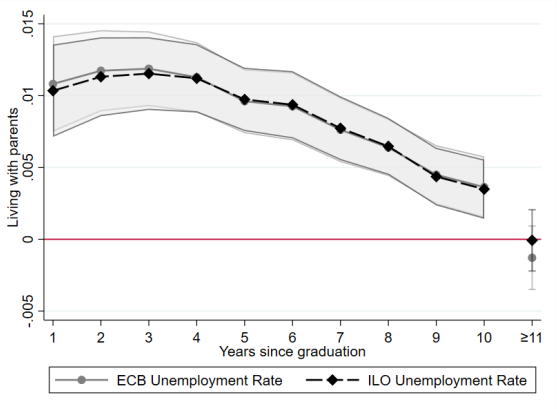
(a) Net Personal Income



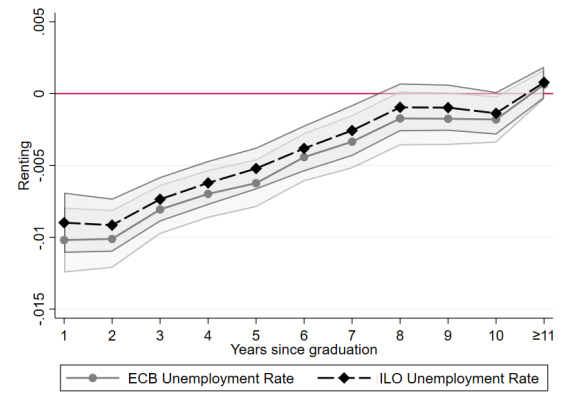
(b) Net Household Income



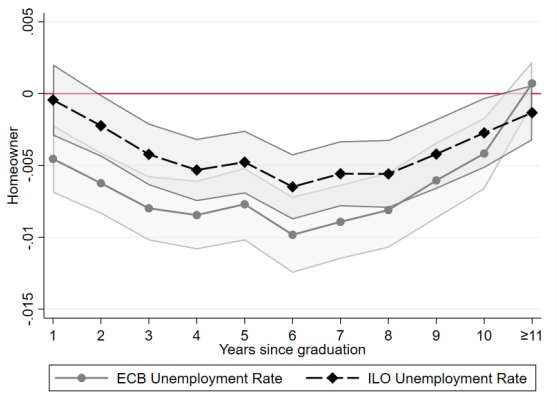
(c) Temporary Employment



(d) Living with Parents



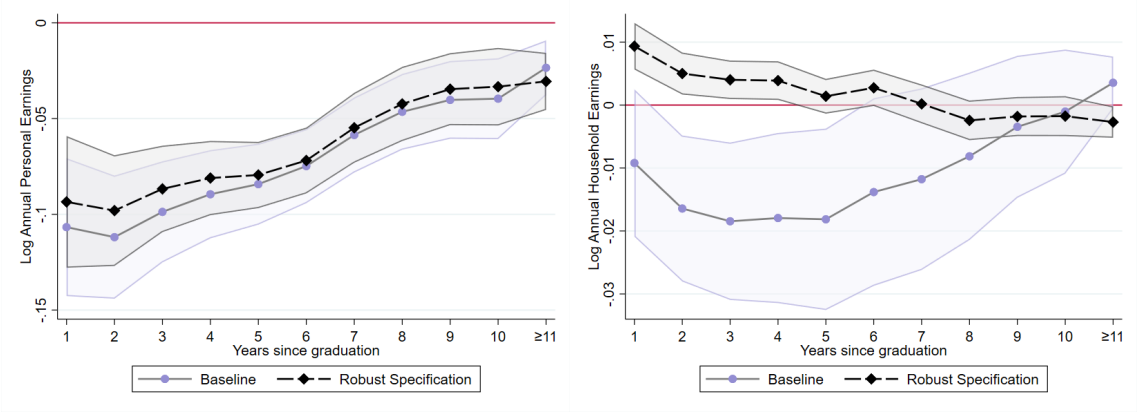
(e) Renting



(f) Owner

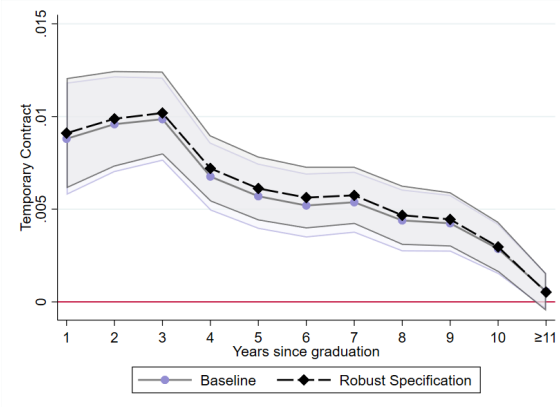
Notes: Effect of a one point increase in the unemployment rate on various outcomes. Results are based on Equation 2. Data from ECHP and EU-SILC.

Figure E.11: Effect of a one-point increase in Unemployment Rate at graduation time on various outcomes using Baseline Specification and adding Country-year Fixed effects.

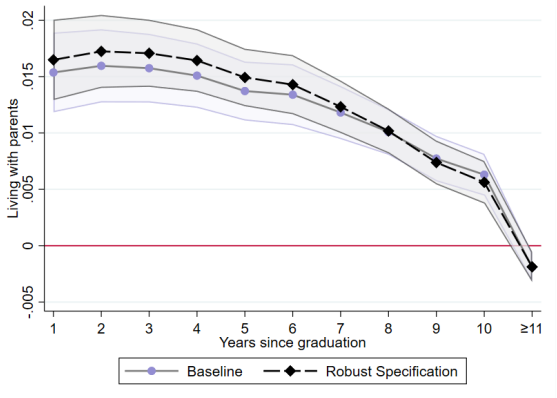


(a) Net Personal Income

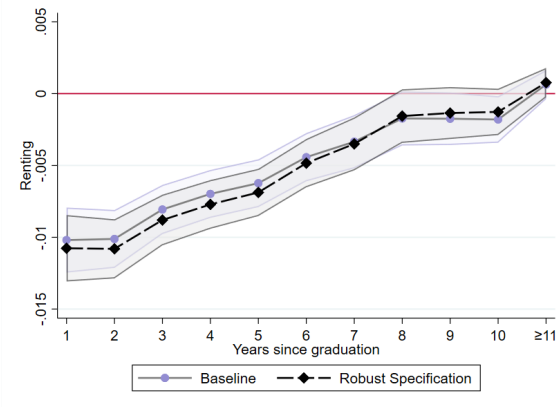
(b) Net Household Income



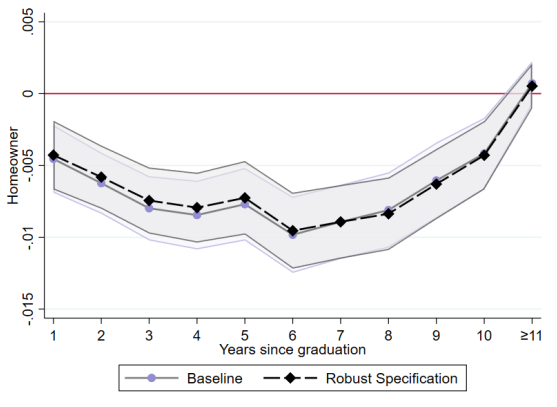
(c) Temporary Employment



(d) Living with Parents



(e) Renting



(f) Owner

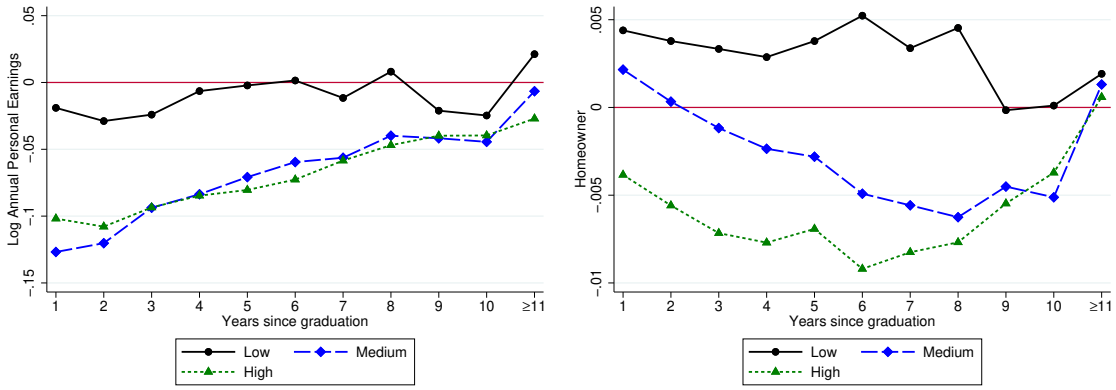
Notes: Effect of a one point increase in the unemployment rate on various outcomes. Results are based on Equation 2. Data from ECHP and EU-SILC.

F Results using all educational levels

When analyzing the result in terms of educational level achieved, there are some noticeable differences. First, lower educated individuals are less affected by an increase in the unemployment rate when finishing their education. In terms of the possibility of becoming a homeowner, the exposure to higher levels of unemployment when graduating

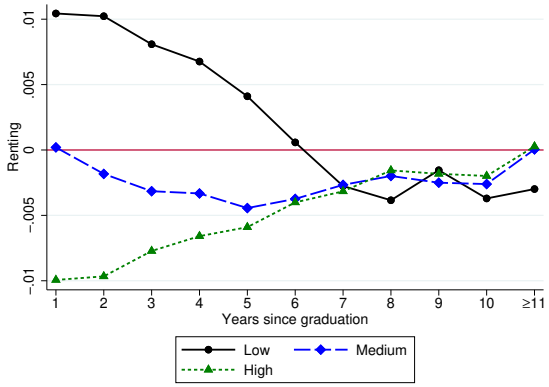
does not seems to affect in a different way according to each educational level. However, in the decision of renting and living with parents there are some differences. In particular, low educated individuals are more likely to rent by themselves rather than living with their parents when unemployment increases. This could be a potential labor market response. In the other hand, higher educated individuals are more likely to stay with their parents rather than rent by themselves. Again this could be a potential response mechanism, in where higher educated individuals can afford to spend longer time unemployed and being su pported by their families and lower educated population can not afford such thing.

Figure F.12: Results by education levels on labor and housing outcomes

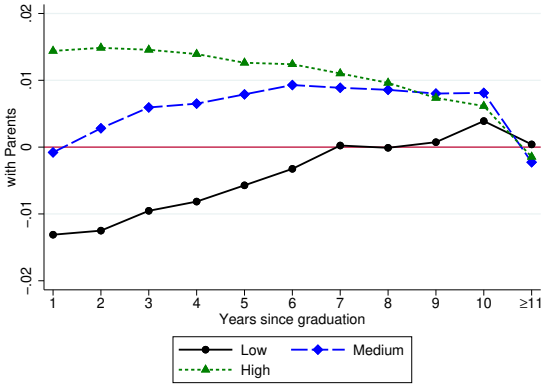


(a) Log Annual Personal Earnings

(b) Owner



(c) Renting



(d) Parents

Notes: Effect of a one point increase in the unemployment rate at the time of graduation on various outcomes. Owner refers to living in owned dwelling by one member of the household, without any parent being present. Similarly, Renting refers to living in a dwelling that is being rented by the households but without any parent present. Finally, with Parents refers to living in a dwelling where at least one parent is present, irrespective of the tenure status. Results are based on Equation 2. Data from ECHP and EU-SILC.

G An Overlapping Generations Model for Housing Tenure

In this section, I develop a theoretical framework to study the effects of an income shock in younger generations has in housing markets. This model builds on the work by Carozzi (2020) and Ortalo-Magne and Rady (2006), where authors propose a tractable model with income and housing heterogeneity with no uncertainty, and with outside options for rental. The framework for this research, adds the possibility of income shocks in young

households. For that, I assume an OLG with no uncertainty, where agents live for two periods with heterogeneity in income but not on housing quality, and the total mass of agent is equal to 1 in each age.

I show that in steady states with lower income for young households and with a non binding outside option, a lower share of them are homeowners and more are living in rental units. This is because these young households are priced out by the older, wealthier agents, and then marginal buyers are then forced to rent. Additionally, I show that in steady-state with lower income for young households and a binding outside option for rental, a larger fraction of them will live with their parents.

The model proposes a set of predictions that will be tested with the micro-level data in section G.1.

Incomes

Agents are born with no wealth but heterogeneous in their income.

Let $e_a(i)$ be he endowment at age $a \in (1,2)$ of type $i \in [0,1]$ such that $e_a(i) \to \mathbb{R}^+$ continuous and increasing. For notation purposes we can also write $e(i) = e_1(i)(1+r)+e_2(i)$

Assumption 1: *$e_1(i)$ can be written as $e_1(i) = \psi e_2(i)$ where $\psi \in (0,1)$.*

Housing Stock

Agents can either: live with their parents, rent, own, or become landlords (owning more than one unit, living in one and renting the other one). The housing stock for ownership is fixed so $\overline{\mathrm{S}} = S^o$. Prices are depicted with p_t, which are prices for housing at time t, and R_t is the rent paid in advance at time t.

An important assumption is that $\overline{\mathrm{S}} < 2$ so no all agents can rent or own a unit, therefore some are forced to live with parents.

Borrowing Constraints

They enter the model via down-payment requirements. Let γp_t be amount borrowed for housing at time t. Then $(1-\gamma)p_t$ is the amount borrowed for housing at t, and $(1-\gamma)p_t$ is the down-payment. Finally, γ represents the maximum LTV ratio.

We impose a restriction in which a household can only have one mortgage at a time. Additionally, we assume: $r < min[\gamma, 1-\gamma]$ so that households can always pay their debt in the SS. There is no default.

Affordability

Agents will pay different sums with respect to each housing tenure choice, in particular they will pay 0 when living with parents, R when renting, and $p(1-\gamma)$ when being homeowners.

Agents dedicate different shares of their income to meet their housing costs, define this ratio for young agents as Aff^{yh} where $h \in [p, r, o]$ for those living with parents, renting, and homeowners respectively.

$$\text{The } Aff^{yh} \text{ will be equal to } \begin{cases} 0 & \text{if living with parents.} \\ \frac{R}{e_1(i)} & \text{if renting.} \\ \frac{p(1-\gamma)}{e_1(i)} & \text{if owner.} \end{cases}$$

Preferences

Preferences are established over a housing and a numeraire good. Let U_{c_t,h_t} be the household's utility, that can be expressed as $U_{c_t,h_t} = c_t + u_h(\tau_t)$ where c_t is the consumption of the numeraire good, and $u_h(\tau_t)$ residential choice in t. Housing tenure decision can be expressed as: $\tau_t = (\tau_{r,t}, \tau_{o,t})'$.

$$\text{The utility derived from this decision is } u_h(\tau_t) = \begin{cases} 0 & \text{if living with parents.} \\ uv_o & \text{if renting.} \\ v_o & \text{if owner.} \end{cases}$$

As $u < 1$ then the utility from renting is lower that of being owner. Finally, there is a utility discount: β, and an interest rate r; and we assume that $\beta(1+r) \geq 1$

Su pply of Rental

The su pply of rental units comes form landlords agents, who own more than one unit, living in one and and renting the other one. Let $\lambda_t(i,a)$ denote the number of units rented by agents of age a, type i at time t. There is no guarantee of $rp = R$ in equilibrium as there are no deep pocketed investors.

There is an outside option for rental, which can be understood as tourists or a reserve value of leaving the accommodation empty. Landlords will decide to rent to young households as long as the rent that they perceive from the them (R^y) is larger than the rent from the outside option (R^o), then the market rent (R) will be: $R = max[R^y, R^o]$.

Timing and Decisions

The timing of the decisions is the following for households: 1.Derive utility. 2. Receive endowment. 3. Pay Interest. 4. Receive Interest. 5.Trade housing. 6. Derive utility from consumption.

Every period agents decide: to buy or not units, to become landlords, where to reside next, and to consume or save. They choose $c_t, h_{t+1}, \tau_{t+1}, \lambda_{t+1}$. But as only households with more than one unit are landlords, then λ_{t+1} is given by h_{t+1}. So, $\lambda_{t+1}(i,a) = \sum h_{t+1}(i,a) - 1$ if $h_{t+1} > 0$ and 0 otherwise. Additionally, as all consumption happens in the last period and the first unit is always owner occupied, then with h_{t+1} and τ_{t+1} all decisions are characterized.

State Variables

Let:

- $b(i,a)$ be the non-housing net wealth s.t. $i, a \to \mathbb{R}$.

- $h(i,a)$ be the housing wealth s.t. $i, a \to \tau_t$.
- $V^a(b,h)$ agents value function at age a.

$\implies V^a(b,h) = max_{(\tau',h)} c + u_h(\tau) + \beta V^{a+1}(b,h)$

Policy functions are $\tau'(i,x,a)$ and $h'(i,x,a)$ which map the type, age, and state of the economy, to the optimal decision. The law of motion for individual non-housing wealth is:
$b' = (1+r)(e_a(i)(1-1[\tau'=0]) + b - c - P(h'-h) + R(\lambda - \tau_r))$

Long-Term Equilibrium

Regarding the housing market we can identify the following features:

- $\mathbb{P}_t = n(R_t, p_t)$ set of prices
- $b_t(i,a)$: gross savings
- $h_t(i,a)$: housing allocations in age/type space:$[0,1] \times [1,2]$
- $\tau_t(i,a)$: housing decisions

$\implies$ Housing market clearing:

- $D_1^R(\mathbb{P}_t) + D_2^R(\mathbb{P}_t) + D_{out}^R(\mathbb{P}_t) 1\{R^y < R^o\} = S^R(\mathbb{P}_t)$
  Demand for rental (from age one and two) and the demand from outside option for rental (if binding) is equal to su pply of rental.
- $S^R(\mathbb{P}_t) + D_1^O(\mathbb{P}_t) + D_2^O(\mathbb{P}_t) = S^o$
  Demand for owner (from age one and two) , plus su pply of rentals must be equal to su pply of owner housing.

Where $S^R(\mathbb{P}_t)$ is su pply of rented units, $D_a^h(\mathbb{P}_t)$ is the demand of h tenure $(Rent, Owner)$ by agent age a buying or renting in t. It is clear here that su pply of owners is exogenous and fixed, while su pply of rental is endogenous.

Parameter Conditions

To ensure that credit constraints are binding for all agents (which implies that incentives for home ownership are always present) and that the Steady State equilibrium has a lifetime transition following a housing ladder (where old potential buyers outbid young ones), the the following conditions must apply:

1. $v_o > e(1)r/(1-\gamma)$: owner occupation is always worth the user cost of housing.
2. $uv_l > R$: renting is always worth the rental price
3. $e_1(2-S^o) > e_1(1)r/(1-\gamma)$: becoming a landowner of a unit is profitable.

Now in order to make the SS with a housing ladder structure we impose that:

4. $e_2(0) > e_1(2-S^o)$: Only young agents are priced out.
5. $e_1(1) < p(2-\gamma) - R$: Only old agents become landlords.
6. $e(1) > p(1-\gamma) + p(1+r) - R$: Some agents are able to own more than one unit
7. $e_2(1) < p(1-\gamma) + 2p - R$: Landlords cannot rent out two properties.

Steady State

In the steady state is possible to state the following price bonds exists:

- $R = e_1(2 - S^o)$
- $P \geq e_1(2 - S^o)(1 - \gamma)^{-1}$

The intuition behind this is the following. For rents, if they were higher there would be a larger share than $2 - S^o$ living with their parents, and if was lower, a larger share than $2 - S^o$ would be able to afford renting, in any case there would not be equilibrium in the rental market. As for prices, if they were lower than $e_1(2 - S^o)(1 - \gamma)^{-1}$, then a mass larger than $2 - S^o$ individuals would be able to own, and markets do not clear. A more detailed proof is in appendix H.1.

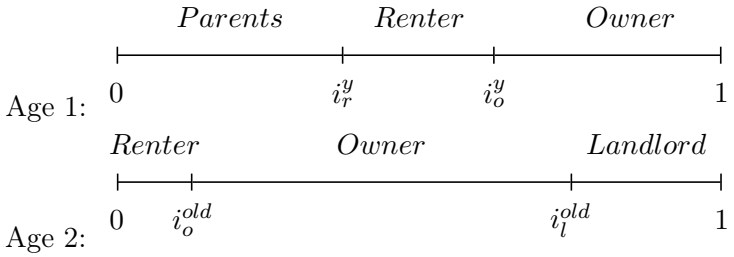
Allocations

We define thresholds in the type distribution of agents that determine the distribution of households across units:

- i_r^y, i_o^y: thresholds for which beyond young agents can afford to rent and own.
- i_r^{old}, i_l^{old}: thresholds for which beyond old agents can afford to own and be landlords (own a unit and rent the other).

The value for each of the thresholds are estimated in appendix H.2, and they can be depicted in the following way:

Figure G.13: Allocations for Steady State



The position of these thresholds depend entirely on the model parameters. But it is possible, by using the assumptions and the price ordering such that $R(1 - \gamma)^{-1} < P$, to prove that the SS allocations will be similar to those shown by Figure G.13, with the following relationship between thresholds:

- $i_r^y < i_o^y < 1 < i_l^y$
- $i_o^{old} < i_r^y$
- $i_r^{old} < i_o^{old} < i_l^{old}$
- $i_h^{old} < i_h^y \; \forall \; h = [R, O]$
- $i_o^y < i_l^{old} < 1$

The proofs for this thresholds inequalities are in appendix H.2. Then the housing market[20] equilibrium conditions are:

[20] Given these thresholds we can use them to also depict the demands for different types of housing: $D_1^R = i_o^y - i_r^y$; $D_2^R = i_o^{old}$; $S^R = 1 - i_l^{old}$; $D_1^O = 1 - i_o^y$; $D_2^O = 1 - i_o^{old}$

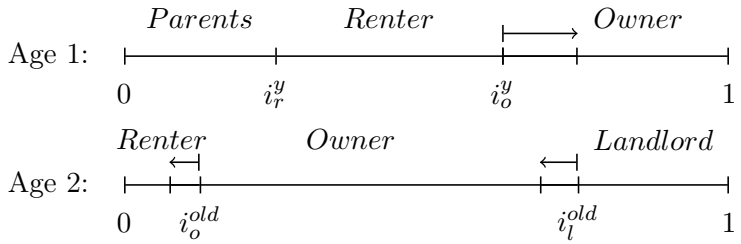
- $3 - i_o^{old} - i_o^y - i_l^{old} = S^o$.
  Which can be read as the demand from old households to own $(1 - i_o^{old})$ plus the demand from young households to own $(1 - i_o^y)$ plus the demand from landlords to own their owner-occupied unit $(1 - i_l^{old})$ must be equal to the total su pply of owner housing (S^o).

- $i_o^{old} + i_o^y - i_r^y = 1 - i_l^{old}$.
  Which can be read as the demand from old households to rent (i_o^{old}) plus the demand from young households to rent $(i_o^y - i_r^y)$ must be equal to the total su pply of rental housing $(1 - i_l^{old})$.

Proposition Case 1: outside option non-binding

A lower ψ leads to a steady state in which less young households are *Owner* and more young households are *Renter*, and less old households are *Renter*. The shock will leads to higher average affordability ratio for young *Owner* and lower ratio young *Renter*. As for housing costs, while rents fully capitalize the shock while prices only capitalize it partially. This new SS can be depicted as shown by Figure G.14.

Figure G.14: Short term changes in allocations for a lower ψ



Notes: This picture depicts the changes in the SS caused by a drop in ψ. With lower incomes, young marginal owners households are forced to rent, while as rents adjust fully to the new income, the share living with aprents remains the same.

Proof: See appendix H.3.

Rents adjust fully to the new income, as they are solely determined by the young agents income, therefore they fall in the same proportion as ψ. Prices in contrast, do not absorb fully the shock as they also depend on the income by old agents. With rents adjusting to the new income, the marginal renter does not change, and neither does the share living with their parent. As prices drop less than the young agents income, the previous marginal owner can no longer afford prices, and now less young agents will be homeowners.

As for older agents, there will be less living in rental units, as they see rents fall but their income remain unchanged. This increases the share of older agents living in owned units. The share of agents becoming landlords will increase or decrease depending on whether the drop in demand from rental units from older agents is larger than the increase in demand for rental units from younger agents. The share of landlord adjust so that rental market is in equilibrium.

As for the affordability, young renters see both rents and income fall in the same proportion, so the affordability ratio should not change. However, the new steady state includes individuals with higher income, that in the previous steady state would have own

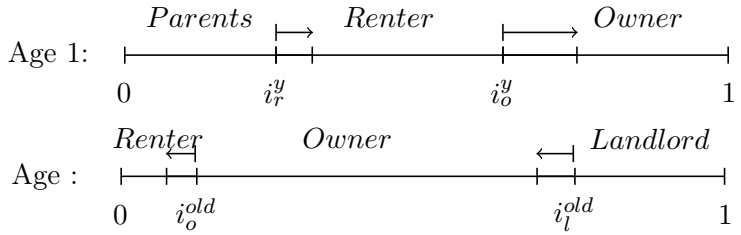
a unit. These "wealthier" agents will have lower affordability ratio, and that causes the average affordability for renters to fall. As for owners, agents have a drop in income but a drop not as large in prices, this will push average affordability up.

Proposition Case 2: outside option binding

A lower ψ leads to a steady state in which less young households are *Owner* and more households are living with *Parents*, while less old households are *Renter*. This also leads to higher average affordability ratio young *Owner*, and potentially also in *Renter*. Prices will partially capitalize the shock, and rents will capitalize the shock depending on how binding is the outside option.

Additionally, in the particular case when the outside option is fully binding (that is that rents capitalize nothing of the shock) the average affordability for young *Renter* will be higher than for young *Owner*. Also it is possible to show that the share of *Landlords* increases. This shifts in the steady state can be depicted as shown by Figure G.15.

Figure G.15: Transitions shifts in allocations for a lower ψ



Notes: This picture depicts the changes in the SS caused by a drop in ψ when the outside option is binding. With lower incomes, young marginal owners are forced to rent, while as are forced to rent.

Proof: See appendix H.4.

Rents are now determined by the outside option, so they will fall in proportion to how binding is the outside option. Prices will partially capitalize the shock, not falling as much as incomes. The marginal renter will now be determined by that individuals whose income is equal to the outside option, an income higher than the new equilibrium rents, therefore there will be more individuals living with their parents. Again as As prices drop less than the young agents income, the previous marginal owner can no longer afford prices, and now less young agents will live with parents.

As for older agents, there will be less living in rental units, as they see rents fall but their income remain unchanged. This increases the share of older agents living in owned units. The share of agents becoming landlords will increase or decrease depending on whether the drop in demand from rental units from older agents is larger than the increase in demand for rental units from younger agents, as those units previously used by renting young agents, are now rented to the outside option. The share of landlord adjust so that rental market is in equilibrium.

As for the affordability ratios, young renters experience a drop in their income but not a equally proportional drop in the rents, if the relative drop in rents is lower than the relative drop in prices, then the average affordability for renters will go up. As for owners, agents have a drop in income but a drop not as large in prices, this will push average affordability up.

In the particular case when the outside option rent is equal to the rent in the initial steady state, rents do not capitalize anything of the shock, the average affordability ratio for renters will increase, and it will be higher than for homeowners. This is because while income fall both for owners and renters, while prices for owners do adjust (although not fully), in this case rents remain the same. There will also be more landlords as princes go down (which makes it cheaper to buy a unit) and rents remain the same, making it more attractive to become a landlord. The rental market is in equilibrium as there is also more demand for rental units coming from young agents.

G.1 Calibration

In order to study the transition period between steady states I use a numerical analysis of the response of the features of the model that are of interest, namely, allocations for young individuals and affordability outcomes. The code is set to solve a recursive equilibrium as noted in appendix H.5.

In each period a N individuals are born in each cohort. Income and parameters satisfy conditions presented on the Parameter Conditions section, which leads to a steady state characterized as Figure G.13. The shock of interest is an unexpected reduction in ψ in period 0. The transition allows prices and rents to adjust as to ensure equilibrium in rental and ownership market across all the transition.

The set of parameters are provided in Table G.15, and they follow those in Carozzi (2020). Housing stock S^o is equal to 1600, which implies that 400 individuals (40% of the young population) will be living with their parents. Income distributions are uniform in all periods. The initial value of ψ is 0.3, which means that old agents income is three times as much of those of the younger individuals. This is broadly in line with data, and ensures that young agents are outbid by older ones even with high levels of γ. I show the case of ψ dro pping up to 0.2. In Table G.15 depicts all the values for the parameters in the transition analysis. I will study two types of scenarios, one in which the outside option is non-binding and one in which the outside option is fully binding.

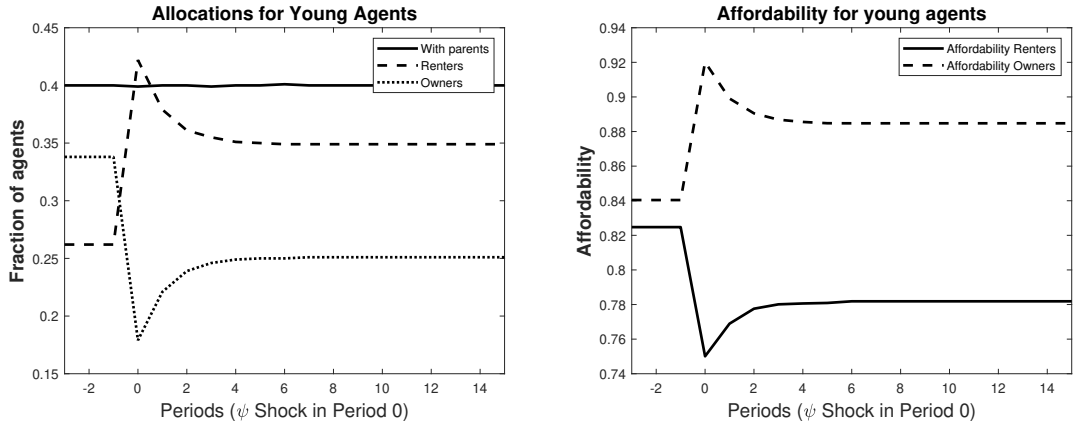
Table G.15: Transition analysis: parameters values

Parameters	Value
Income Period 2,3	U(3,20)
ψ_i	0.3
ψ_f	0.2
v	400
μ	0.5
S^o	1600
r	0.01
γ	0.7

The transition towards a steady state with a lower ψ with a non-binding outside option is depicted in Figure G.16. The left graph shows the allocations for young individuals, and the right one depicts the affordability ratios for young individuals. In line with predictions of the model, the number of young agents living with their parents remains unchanged, while there is a trade-off between ownership and renting. The final state is reached within four periods, in which markets adjust in such a way as there is always equilibrium.

The periods immediately after the shock there is a spike in the share of renters (and a low point in ownership) as prices tend to adjust more slowly than individuals incomes. As for the graph on the right, it depicts the evolution of the affordability ratios. After reaching the new steady state, rental households have lower affordability ratios, as there are new "wealthier" renters. As for owners, the average affordability ratio goes higher, as prices fall less than young agents income.

Figure G.16: Transitions after an income shock on young individuals, with non binding outside option.



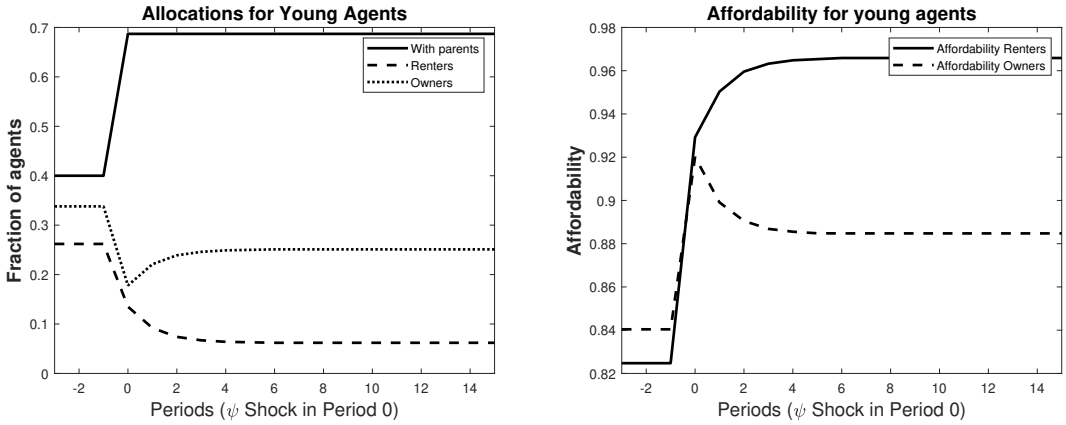
(a) Young agents allocations **(b)** Young agents affordability

Notes: The left panel depicts the transition for the allocation of young individuals, while the right panel shows the transition for the average affordability ratio.

The transition for the case in which the outside option is fully binding is shown in Figure G.17. The left graph shows the allocations for young individuals, while the right one shows the transition for the affordability ratios. In line with predictions of the model, the number of young agents living with their parents increases, while there is a decrease in the number of young agents living in rental units and in owned units. The size of the increase in the share of young individuals living with parents will be linked to how binding is the outside option. The more inflexible the rents are, the more younger agents will be forced to live with their parents. While the final equilibrium is reached within two periods for agents living with parents, for rental and ownership agents, as markets need to be in equilibrium it takes up to four periods to reach the final allocation.

As for the average affordability it is possible to see that the ratio increases both for renters and owners, and in line with the predictions, is larger for renters. The transition reaches its final steady state allocations and affordability in four periods. In period zero the share of renters peaks (as the share of owners reaches its minimum) because prices do not adjust immediately (as to maintain equilibrium in the markets), making ownership unaffordable for a greater share of young agents.

Figure G.17: Transitions after an income shock on young individuals, with binding outside option.



(a) Young agents allocations **(b)** Young agents affordability

Notes: The left panel depicts the transition for the allocation of young individuals, while the right panel shows the transition for the average affordability ratio.

These results, and more particularly those in which the outside option is binding, are similar to those found in the empirical section of the paper.

H Theoretical Framework Proofs

In this sections I provide the different proofs and derivations required for the model. This sections is organized as follows:

1. Price Bonds and Rental Market
2. Thresholds
3. Proof Proposition Case 1
4. Proof Proposition Case 2
5. Recursive equilibrium form
6. Indirect utilities in the Steady State

H.1 Price bonds

- $R = e_1(2 - S^o)$.
  Proof (by contradiction):
  - Assume that $R < e_1(2 - S^o)$, and considering that $u_v > e_(2 - S^o)$, then households that are not able to occupy would rent, so a mass larger that $2 - S^o$ would be willing to rent in age 1, and in age 1 and 2. Which would create and excess demand, so $R \geq e_1(2 - S^o)$.
    Now assume that $R > e_1(2 - S^o)$ then a mass larger that $2 - S^o$ of young households would be homeless by the end of each period. So rental markets would not clear, then $R \leq e_1(2 - S^o)$.
    Then $R = e_1(2 - S^o)$.

Additionally:

- $P \geq e_1(2 - S^o)(1 - \gamma)^{-1}$
  Proof (by contradiction):
  - Assume $P < e_1(2-S^o)(1-\gamma)^{-1}$, which is equal to $P(1-\gamma) < e_1(2-S^o)$. This implies that a mass of agents age 1 that can buy a unit is $m_o^1 > 1 - (2 - S^o)$, but as older agents outbuy younger ($e_2(0) > e_1(2 - S^o)$), then $m_o^2 = 1$. This implies that $m_o = m_o^1 + m_o^2 > S^o - 1 + 1 = S^o$. So more can afford to own than the actual offer of, so the solution is that $P \geq e_1(2 - S^o)(1 - \gamma)^{-1}$.

Finally, rental markets exists as long as there are incentives to rent and some agents are able to own two units. This is ensured with conditions 1 to 6. Condition X ensure that at least some agents are able to own when young and then buy another unit when old. There will be incentives to rent as long as $R > rp$ and as the market equilibrium condition ensures that $R = e_1(2 - \overline{S})$, then Condition 3 ensure the existence of rental market.

H.2 Thresholds

So the thresholds for young agents are:

- $i_r^y = e_1^{-1}(R)$
- $i_o^y = e_1^{-1}(p(1-\gamma))$
- $i_l^y = e_1^{-1}(p(1-\gamma) + p)$

And the thresholds for old agents are:

- $i_r^o = e^{-1}(R)$
- $i_o^o = e^{-1}(p(1-\gamma) + (1+r)R)$
- $i_l^o = e^{-1}(p(1-\gamma) + (1+r)p - R)$

Proof: $i_r^y < i_o^y < 1 < i_L^y$
This conditions follows from the relation on prices $R < (1-\gamma)p$. If we consider also the previous mentioned restriction $e_2(0) > e_1(2 - S^o)$ and the price bound $R = e_1(2 - S^o)$, the we have that $i_r^{old} < 0$, which means old agents always afford renting. Finally, $1 < i_l^y$ is ensured by Condition 5.

Proof: $i_r^{old} < i_o^{old} < i_l^{old}$
This conditions is true given the prices ordering $r < (1-\gamma)p$ and what we know about period one decision from condition $i_o^y > i_o^{old}$, this let us prove that $i_r^{old} < i_o^{old}$. ...

Proof: $i_h^{old} < i_h^y \ \forall \ h = [R, O]$
For the case of $i_r^o < i_r^y$, we know that $i_r^{old} < 0$, and that i_r^y must be larger than zero, as otherwise there will be no agents living with their parents.

As for $i_o^o < i_o^y$, there are two scenarios, when $i_o^o = e_2^{-1}(p(1-\gamma))$ and when $i_o^o = e^{-1}(p(1-\gamma)) + R(1+r))$. On the first case agents were living with their parents, while on the second case they were living in rental units.

On the first case, when $i_o^o = e_2^{-1}(p(1-\gamma))$, as we know that $e_1(i) < e_2(i) \forall i$ then $e_2^{-1}(p(1-\gamma)) < e_1^{-1}(p(1-\gamma))$ is proved. As for the case when $i_o^o = e^{-1}(p(1-\gamma)) + R(1+r))$ we know it to be true as having rented when young requires more income than on the first case.

Proof: $i_o^y < i_l^o < 1$
The statement $i_l^{old} < 1$ is given by the existence of rental markets, proven in the appendix.

To prove that $i_o^y < i_l^o$, using condition 6...

H.3 Proof Proposition Case 1

The case with non binding outside option can be characterized as one in which $R_f > R^o$ with R_f being the rent after the income shock. That is that the rent in the new steady state is still larger than the outside option rent.

As a general tool for the proofs, first lets assume $g_a(x) = \dfrac{\partial e_a^{-1}(x)}{\partial x}$ and $g(x) = \dfrac{\partial e^{-1}(x)}{\partial x}$. With both functions being positive. Additionally as $e_1(i) = \psi e_2(i)$ we can say that $e_1^{-1}(i) = e_2^{-1}(\dfrac{1}{\psi}i)$.

A. To prove the changes in housing tenure we need to derive the thresholds for housing allocation:

1. First the thresholds regarding agents living with parents i_r^y,

$$\frac{\partial i_r^y}{\partial \psi} = \frac{\partial e_1^{-1}(R)}{\partial \psi} = \frac{\partial e_2^{-1}(\frac{1}{\psi}R)}{\partial \psi}$$

Which gives:

$$\frac{\partial e_1^{-1}(R)}{\partial \psi} = g_2\left(\frac{1}{\psi}R\right)\left[\frac{-R}{\psi^2} + \frac{\partial R}{\partial \psi}\right]$$

As in equilibrium and with the outside option non binding $R = e_1(2 - S^o) = \psi e_2(2 - S^o)$ then:

$$\frac{\partial e_1^{-1}(R)}{\partial \psi} = g_2\left(\frac{1}{\psi}R\right)\left[\frac{-\psi e_2(2 - S^o)}{\psi^2} + \frac{e_2(2 - S^o)}{\psi}\right]$$

Which means that $\dfrac{\partial i_r^y}{\partial \psi} = 0$. Then there are the same share of young individuals living with their parents.

2. The second threshold determines the share of old agents living in owned units i_o^o:

$$\frac{\partial i_o^o}{\partial \psi} = \frac{\partial e^{-1}(p(1-\gamma) + R(1+r))}{\partial \psi}$$

Which gives:

$$\frac{\partial i_o^o}{\partial \psi} = g(p(1-\gamma) + R(1+r))\left[\frac{\partial p}{\partial \psi}(1-\gamma) + \frac{\partial R}{\partial \psi}(1+r)\right]$$

As we know that $g(.)$ is always positive and assuming that $\dfrac{\partial p}{\partial \psi} > 0$, then: $\dfrac{\partial i_o^o}{\partial \psi} > 0$. Which implies that there are less old agents living in rental units.

3. The third threshold determines the share of young agents living with as homeowners i_o^y. Given the threshold's value:

$$\frac{\partial i_o^y}{\partial \psi} = \frac{\partial e_1^{-1}(p(1-\gamma))}{\partial \psi}$$

Now this can be rewritten as:

$$\frac{\partial e_2^{-1}(\frac{1}{\psi}p(1-\gamma))}{\partial \psi} = g_2\left(\frac{1}{\psi}p(1-\gamma)\right)\left[\frac{-p}{\psi^2}+\frac{\partial p}{\partial \psi}\frac{1}{\psi}\right](1-\gamma)$$

In order to prove that $\frac{\partial p}{\partial \psi} < \frac{p}{\psi}$ I will proceeded by contradiction, and show that any other option does not allow for market equilibrium. For that assume that $\frac{\partial p}{\partial \psi} \geq \frac{p}{\psi}$, this implies that $\frac{\partial i_o^y}{\partial \psi} \geq 0$. Additionally as :

$$\frac{\partial i_l^o}{\partial \psi} = \frac{\partial e^{-1}(p(1-\gamma)+(1+r)p-R}{\partial \psi}$$

Which gives:

$$\frac{\partial i_l^o}{\partial \psi} = g(p(1-\gamma)+(1+r)p-R)\left[\frac{\partial p}{\partial \psi}(1-\gamma)+\frac{\partial p}{\partial \psi}(1-r)-\frac{\partial R}{\partial \psi}\right]$$

As $\frac{\partial p}{\partial \psi} \geq \frac{p}{\psi}$ then:

$$\left[\frac{\partial p}{\partial \psi}(1-\gamma)+\frac{\partial p}{\partial \psi}(1-r)-\frac{\partial R}{\partial \psi}\right] \geq \left[\frac{p}{\psi}(1-\gamma)+\frac{p}{\psi}(1-r)-\frac{\partial R}{\partial \psi}\right]$$

As we know that $P \geq \psi e_2(2-\overline{S})(1-\gamma)^{-1}$ and that $R = \psi e_2(2-\overline{S})$, then:

$$\left[\frac{p}{\psi}(1-\gamma)+\frac{p}{\psi}(1-r)-\frac{\partial R}{\partial \psi}\right] \geq e_2(2-\overline{S})+e_2(2-\overline{S})(1+r)(1-\gamma)^{-1}-e_2(2-\overline{S}) > 0$$

Which implies that $\frac{\partial i_l^o}{\partial \psi} > 0$.

If we consider that the market equilibrium condition must still apply, we can write that $3-i_o^o-i_y^o-i_o^l = \overline{S}$, which implies that $-\frac{\partial i_o^o}{\partial \psi}-\frac{\partial i_y^o}{\partial \psi}-\frac{\partial i_o^l}{\partial \psi} = 0$

Now if we take this all these results and add the market clearing conditions:

- $\frac{\partial i_o^o}{\partial \psi} > 0$
- $\frac{\partial i_y^o}{\partial \psi} \geq 0$
- $\frac{\partial i_o^l}{\partial \psi} > 0$
- $-\frac{\partial i_o^o}{\partial \psi}-\frac{\partial i_y^o}{\partial \psi}-\frac{\partial i_o^l}{\partial \psi} = 0$

Which cannot be simultaneously true, therefore $\frac{\partial p}{\partial \psi} < \frac{p}{\psi}$, which gives that $\frac{\partial i_o^y}{\partial \psi} < 0$. This implies less young agents living in owned units. This leaves the sign of $\frac{\partial i_o^l}{\partial \psi}$ undetermined.

4. Finally we can derive the rental market equilibrium, $i_o^y + i_o^o + y_r^y = 1 - i_l^o$, wrt ψ:

$$\frac{\partial i_o^y + i_o^o + y_r^y}{\psi} = \frac{\partial 1 - i_l^o}{\partial \psi}$$

As we know that $\frac{\partial i_o^y}{\partial \psi} < 0$, $\frac{\partial i_o^o}{\partial \psi} > 0$, and $\frac{\partial i_r^y}{\partial \psi} = 0$, the sign of $1 - i_l^o$ will depend on which effect dominates, if the increase in rental units from young agents or the drop in rental units from older agents.

B. The second part of the proposition refers to the affordability ratios. First lets define ψ_i, R_i and p_i as the equilibrium parameters values before the shock, and in the same way ψ_f, R_f and p_f as the equilibrium parameters after the shock. So to prove the changes in affordability ratios we need to prove first that:

$$\frac{\psi_f}{\psi_i} = \frac{R_f}{R_i} < \frac{P_f}{P_i}$$

These inequalities imply that while rents will change in the same proportion as ψ, prices will change in a less than the changes in ψ.

The first part implies that the ψ-elasticity of R is equal to one, which can be proved as:

$$\varepsilon_{R,\psi} = \frac{\partial R}{\partial \psi} \times \frac{\psi}{R} = \frac{\partial(\psi e_2(2 - \overline{S}))}{\partial \psi} \times \frac{\psi}{\psi e_2(2 - \overline{S})} = 1$$

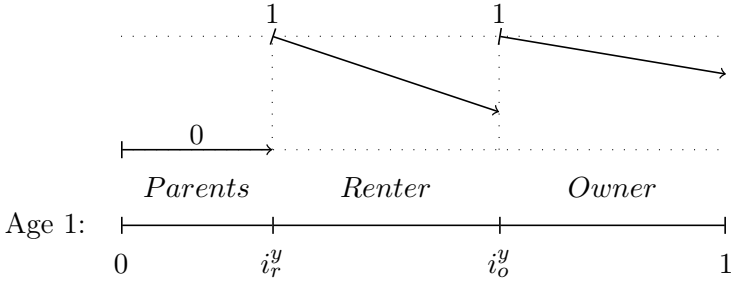
This is in line with previousresults, as it implies that rents fully capitalize the shock, and respond one-to-one to changes in ψ.

The second inequality implies that prices do not fully adjust to a shock in ψ. This is the same as saying that the ψ-elasticity of p is lower than one. Using that $\frac{\partial p}{\partial \psi} < \frac{p}{\psi}$ we get that:

$$\varepsilon_{p,\psi} = \frac{\partial p}{\partial \psi}\frac{\psi}{p} < \frac{p}{\psi}\frac{\psi}{p} = 1$$

This follows the intuition behind that while on one hand rents fully capitalize the income shock, as they are determined solely by young agents income, prices on the other hand, do not fully capitalize the shock as they are also determined by older agents income (which are unaffected), therefore falling less than rents.

The affordability in the steady state for young agents can be illustrated in the following way:



As mentioned before the affordability refers to the ratio between what agents pay for their housing tenure and its income. Now the average affordability for young renters (owners), will be the average between the marginal renter (owner) affordability and the wealthiest renter (owner) affordability.

Define φ_i^{yr} and φ_f^{yr} as the initial and final average affordability of renters, which

can be calculated as the average between the marginal renter and the wealthiest renter affordability:[21]

$$\varphi_i^{yr} = \frac{\frac{R_i}{e_{i1}(i_r^y)} + \frac{R_i}{e_{i1}(p_i(1-\gamma))}}{2} = \frac{1}{2} + \frac{R_i}{2p_i(1-\gamma)}$$
$$\varphi_f^{yr} = \frac{1}{2} + \frac{R_f}{2p_f(1-\gamma)}$$

The ratio has two parts, the first one refers to the marginal renter located in i_r^y that will dedicate all of its income to renting and therefore have and affordability ratio equal to one. The second one is the "wealthiest" renter, that just below the marginal owner, that will have an income approximately the same the marginal owner, but will pay only R for its income. The average affordability for renters after the income shock is calculated in an analogous way, but now with the final rents and prices. Now it can be proved that:

$$\varphi_i^{yr} > \varphi_f^{yr} \iff \frac{1}{2} + \frac{R_i}{2p_i(1-\gamma)} > \frac{1}{2} + \frac{R_f}{2p_f(1-\gamma)} \iff \frac{p_f}{p_i} > \frac{R_f}{R_i}$$

With the last inequality being proved before.

In a similar way it is possible to check the changes in average affordability for young homeowners:

$$\varphi_i^{yo} = \frac{\frac{p_i(1-\gamma)}{e_{i1}(i_o^y)} + \frac{p_i(1-\gamma)}{e_{i1}(1)}}{2} = \frac{1}{2} + \frac{p_i(1-\gamma)}{2e_{i1}(1)}$$
$$\varphi_f^{yo} = \frac{1}{2} + \frac{p_f(1-\gamma)}{2e_{f1}(1)}$$

In a similar way to renters, the average affordability is the average between the marginal owners affordability ratio, who spends all of its income to down-payment and therefore is one. And the "wealthiest" homeowner, which has an income equal to $e_1(1)$. Now to prove that affordability ratios increases after the shock we need to prove that:

$$\varphi_i^{yo} < \varphi_f^{yo} \iff \frac{1}{2} + \frac{p_i(1-\gamma)}{2e_{i1}(1)} < \frac{1}{2} + \frac{p_f(1-\gamma)}{2e_{f1}(1)} \iff \frac{p_f(1-\gamma)}{p_i(1-\gamma)} > \frac{e_{f1}(1)}{e_{i1}(1)}$$

With the last term $\frac{e_{f1}(1)}{e_{i1}(1)}$ being equal to $\frac{\psi_f}{\psi_i}$, which confirms the last inequality as $\frac{p_f}{p_i} > \frac{\psi_f}{\psi_i}$ has already been proved.

H.4 Proof Proposition Case 2

The case for binding outside option can be characterized as one in which $R_f < R^o$, that is that the rent from the final steady state is lower than the outside option one.

A. The proof of the case when the outside option is binding is very similar to the previous case. In fact the proof for the effect on i_o^y, i_o^o and i_l^o are the same.

[21] The wealthiest renter will be the agent that can just not afford to own. As the income distribution is continuous I can assume that the income of the wealthiest renter will be approximately equal to that of the marginal owner ($e_1(p(1-\gamma))$).

As for the changes in the share of agents living with their parents i_r^y:

$$\frac{\partial i_r^y}{\partial \psi} = \frac{\partial e_1^{-1}(R)}{\partial \psi} = \frac{\partial e_2^{-1}(\frac{1}{\psi}R)}{\partial \psi}$$

Which gives:

$$\frac{\partial e_1^{-1}(R)}{\partial \psi} = g_2\left(\frac{1}{\psi}R\right)\left[\frac{-R}{\psi^2} + \frac{\partial R}{\partial \psi}\right]$$

As with the outside option binding $R = R^o$ (with R^o exogenous) then $\frac{\partial R^o}{\partial \psi} = 0$ and:

$$\frac{\partial e_1^{-1}(R)}{\partial \psi} = g_2\left(\frac{1}{\psi}R\right)\left[\frac{-R^o}{\psi^2}\right]$$

Which means that $\frac{\partial i_r^y}{\partial \psi} < 0$. Then there are more young individuals living with their parents.

B. Now it is possible to prove that with the outside option binding, the average affordability for renters can increase. As in the previous part, the average affordability for renters before and after the shock is:

$$\varphi_i^{yr} = \frac{1}{2} + \frac{R_i}{2p_i(1-\gamma)}$$
$$\varphi_f^{yr} = \frac{1}{2} + \frac{R^o}{2p_f(1-\gamma)}$$

So therefore:

$$\varphi_i^{yr} < \varphi_f^{yr} \iff \frac{1}{2} + \frac{r_i}{2p_i(1-\gamma)} < \frac{1}{2} + \frac{R^o}{2p_f(1-\gamma)} \iff \frac{R^o}{R_i} > \frac{p_f}{p_i}$$

So the average affordability ratio will increase as long as rents absorb less of the shock than prices. In the particular case for $R^o = R_i$ we will have that:

$$\varphi_i^{yr} < \varphi_f^{yr} \iff 1 > \frac{p_f}{p_i}$$

The intuition behind this is that young renters will have lower income, but as rents do not adjust, this will increase the affordability ratio for those already renting.

Additionally, for the case in which the outside option is fully binding, we can prove that after the shock, the average affordability for renters will be higher than those of owners:

$$\varphi_f^{yr} > \varphi_f^{yo} \iff \frac{1}{2} + \frac{R^o}{2p_f(1-\gamma)} > \frac{1}{2} + \frac{p_f(1-\gamma)}{2e_{f1}(1)} \iff \frac{R^o}{p_f(1-\gamma)} > \frac{p_f(1-\gamma)}{e_{f1}(1)}$$

As we know, even when the outside option is binding, rents and prices must comply with $R < p(1-\gamma)$, which allows us to say that:

$$\frac{R^o}{p_f(1-\gamma)} > \frac{p_f(1-\gamma)}{e_{f1}(1)} > \frac{R^o}{e_{f1}(1)} \iff \frac{e_{f1}(1)}{p_f(1-\gamma)} > 1$$

Which the last part we know to be true as the wealthiest young household must be

able to afford a down-payment for a unit.

H.5 Recursive Equilibrium

The recursive equilibrium is compromised by: set of decisions rules for housing purchases, tenure choice and becoming landlord, value function. price functions mapping the state of the economy to the real line, and set of states of the economy, and a law of motion for the state of the economy. The conditions for these to for a recursive equilibrium are:

H.5.1 State Variables

The state of the economy at the beginning of the period is given by:

$$x = (h(i,2), h(i,3), b(i,2), b(i,3))$$
$$\text{with } h(i,a) : [0,1] \to N^+ \text{ and } b(i,a) : [0,1] \to R$$

in which $h(i,2)$ and $h(i,3)$ map agents types to their owned units at age 2 and 3. Analogously, $b(i,2)$ and $b(i,3)$ map the non-housing wealth of agents i at age 2 and 3.

H.5.2 Choice Variables

In each period, individuals decide for $a = [1,2]$: housing assets $h'(i,x,a)$, non housing assets $b'(i,x,a)$, tenure choice $\tau'(i,x,a)$ and the decision to become a landlord $\gamma'(i,x,a)$.

H.5.3 Constraints

Three constraints fall into agents decisions. budget, credit and housing tenure constraints.

Budget constraints (law of motion of non-housing assets) for $a = 1,2$:

$$b'(i,b,h,h',x,a) =$$
$$(1+r)(e_a(i)(1-1\{\tau'(i,a)=0\}) + b(i,a) - c - p(h'(i,x,a) - h(i,a) + R(\lambda'(i,x,a) - \tau'_R(i,x,a))))$$

Credit constraints, as to ensure mortgage on one unit only for $a = 1,2$:

$$\Gamma(i,b,h,h',x,a) = \{h' \in N^2 : e_a(i) + b + Ph(i,x,a) \geq \gamma P(x) 1\{h' > 0\}\}$$

Tenure constraints, as to ensure that owner occupation can only be done if being a homeowner for $a = 1,2$:

$$\tau'(i,x,a) \in \{0,1\} \text{if } h'(i,x,a) \geq 1$$
$$\tau'(i,x,a) = 0 \text{if } h'(i,x,a) = 0$$

H.5.4 Value Functions and Decisions Rules

Now its time to define policy functions: f_h for housing assets, f_τ for housing tenure and f_λ for becoming a landlord. Non-housing functions follow the law of motion of wealth previously discussed.

Housing Assets

$$f_h(i,x,1) \text{ solves } v_1(i,x) = \max_{h' \in \Gamma(i,0,0,h',1)} v_2(i, b'(i,0,0,h',1), h', x')$$

$$f_h(i,x,2) \text{ solves } v_2(i,x) = \max_{h' \in \Gamma(i,b,h,h',x,2)} u_h(\tau(i,2) + \beta v_3(i, b'(i,b,h,h',2), h', x')$$

$$f_h(i,x,3) \text{ solves } v_3(i,x) = \max_{h' \in \Gamma(i,b,h,h',x,3)} u_h(\tau(i,3) + b + P(h-h') - b'(i,b,h,h',x')$$

Becoming a Landlord

$$\lambda(i,x,a) = \begin{cases} h'(i,x,a) - \tau'(i,x,a) \text{ if } R(x) \geq 0 \\ 0 \text{ otherwise} \end{cases}$$

Housing tenure
For values large enough of v_o:

$$\tau(i,h,a) = \begin{cases} (0,1) \text{ if } h(i,x,a) \geq 1 \\ (1,0) \text{ if } b + e_a(i) > R(x) \ \& \ h(i,x,a) = 0 \end{cases}$$

Housing Market Clearing Conditions

$$\int h'(i,x,2) + h'(i,x,3) \ di = S^o$$
$$\int \lambda'(i,x,2) + \lambda'(i,x,3) \ di = \int \tau'_R(i,x,2) + \tau'_R(i,x,3) \ di$$

Law of Motion
The law of motion is given by:

$$b(i,2) = b'(i,0,0,f_h(i,x,1),1)$$
$$b(i,3) = b'(i,b(i,2),h(i,2),f_h(i,x,2),1)$$
$$h(i,2) = f_h(i,x,1)$$
$$h(i,3) = f_h(i,x,2)$$

H.6 Indirect utilities in Steady State

Assuming that $\beta(1+r) \geq 1$ the we can assume that consumption by agents takes place at age 3. In steady state the prices that they face are the same along their life periods.

Indirect utilities foe each path of lifetime tenure choices are:

$$
\begin{aligned}
V^{P,P} &= \beta^2[e_3(i)] \\
V^{P,R} &= \beta^2[e_2(i)(1+r) + e_3(i) - (1+r)R] + \beta^2\mu v_o \\
V^{R,R} &= \beta^2[e(i)(1+r) + e_3(i) - R((1+r) + (1+r)^2)] + \beta^2\mu v_o + \beta\mu v_o \\
V^{R,O} &= \beta^2[e(i)(1+r) + e_3(i) - R(1+r)^2 - rp] + \beta^2 v_o + \beta\mu v_o \\
V^{O,O} &= \beta^2[e(i)(1+r) + e_3(i) - (r^2+2r)p] + \beta^2 v_o + \beta v_o \\
V^{O,L} &= \beta^2[e(i)(1+r) + e_3(i) - (r^2+2r)p + (1+r)R] + \beta^2 v_o + \beta v_o
\end{aligned}
$$

In steady state, housing prices p have to be smaller than $e(1)/(1-\gamma)$ so to ensure that at least the richest young agent can afford to buy. Then by assumption 1 we can say that owner occupation is always worth the cost. As rents are pinned by income distribution, $R = e_1(2 - S^o)$, if rental market exists. Then using assumptions a1 and a2 on preference parameters, and the prices bonds, and the expressions for indirect utilities we can say that:

$$V^{O,L} > V^{O,O} > V^{R,O} > V^{R,R} > V^{P,R} > V^{P,P}$$

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